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The American

GAS LIGHT JOURNAL.

(ILLUSTRATED.)

DEVOTED TO THE INTERESTS OF

ILLUMINATION, HEATING, MECHANICAL, CHEMICAL

—AND—

GENERAL SCIENCE.

VOLUME LXXVIII.

(FORTY-FIFTH YEAR.)

FROM JANUARY 1 TO JUNE 30, 1903.

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A. M. CALLENDER & CO., Publishers.

OFFICE OF PUBLICATION, NO. 42 PINE STREET, NEW YORK CITY.

Advertisements of Books.

THE ART OF PRINTING.

Published every Saturday, price 2d.

Terms of Subscription, 10s. 6d. per annum, payable in advance.

Communications, Books for Review, and Exchanges, to be addressed to the Editor, 4, Stationers' Hall Court, London, E.C.

Orders and Subscriptions to be addressed to the Publisher, 4, Stationers' Hall Court, London, E.C.

The Publication Office is open from 10 to 4 daily.

Remittances should be made payable to the Publisher, and crossed "London and Westminster Bank, Limited."

Books for Review must be sent to the Publication Office.

The Publisher cannot undertake to return Books sent for Review unless specially requested to do so.

Editorial Communications should be addressed to the Editor, 4, Stationers' Hall Court, London, E.C.

Advertisements must be sent to the Publication Office not later than the 20th of the month.

Terms for Advertisements may be had on application to the Publication Office.

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Terms for Subscription, Advertisements, &c., may be had on application to the Publication Office.

The Publication Office is open from 10 to 4 daily.

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THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXVIII. No. 1. Whole No. 1,439. | NEW YORK, MONDAY, JANUARY 5, 1903. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, New York.

Telephone.—2996 John.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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BRIEFLY TOLD.

A GRACEFUL TRIBUTE TO A WORTHY MAN.—On December 23d, Mr. A. M. Smith, the well-known Superintendent of Distribution, under Chief Engineer W. H. Bradley of the Consolidated Gas Company, of this city, was the recipient of a well deserved compliment delivered in a very happy manner. It was in the shape of a handsome loving cup, the inscription on which tells the story in an eloquent, though concise manner, as follows: "A gift from the Consolidated Gas Company, of New York, to Albert M. Smith in recognition of 50 years faithful, service, 1852-1902." On the other side the initials of "A. M. S." were engraved in monogram. The presentation was made by the President of the Company, Mr. H. E. Gawtry, in a few well chosen sentences, and in his office, where all the officers were present. Mr. Gawtry, among other things, said that it was not given to many men to be so long connected with a gas company, without becoming the owner of it, and that the fact spoke volumes for the faithfulness of Mr. Smith in the interest of his employers rather than in his own interest. The gift was a complete surprise to Mr. Smith, who was unable through emotion to do more than in the briefest way express his thanks and appreciation. Congratulations and wishes that another 50 years of useful and honorable life might be his were showered upon Mr. Smith by the officers present, and closed an incident most enjoyable and appropriate for the season of goodwill. Mr. Smith's long connection with the Company began as an office boy, when the old Manhattan Company's headquarters were at No. 80 Fourth avenue. From that position he was transferred to the 14th street station, when that was put in operation. There he remained 19 or 20 years, under the late Mr. Wm. Combe, as Superintendent. With such excellent training he was admirably fitted for his next position, that of Superintendent of the Manhattan Company's 18th street station, which he filled for well over 25 years with honor to himself and satisfaction to his employers. The JOURNAL joins his other friends in wishing him many years of happiness in his present responsible position.

"GAS ANALYST'S MANUAL," by Jacques Abady, M. Inst., M.E.—Published by Spon & Chamberlain, N. Y.—This book seems to be a conscientious effort to bring to date the two books of the so much lamented Mr. Hartley, which the title page says are incorporated in it, but which the preface implies, form but a small part of the whole. This seems to be true. The work will be looked upon by the new generation of users, not as Mr. Hartley's, but, as it really is, that of Mr. Jacques Abady.

Taken as a whole, it is a very convenient book. Between its covers one finds pretty much all that is wanted for the purposes it seems to have in view. The apparatus described is no doubt that most in use in England, and probably it stands for the practice which the struggle for survival has proved fittest for survival *in England;* but one cannot but doubt if the book will be so influential as to insure the introduction, use and survival in this country of the apparatus and methods which it seems to "most approve." There is no body sufficiently influential to give its approval, even the semblance of authority in the question of the choice of apparatus, and the disposition of every man in America to be his own guide in his own matters makes against uniformity in choice of apparatus. Yet such is the influence of a really great author that

many men follow his leading even to their own undoing. For illustration, see how common is the use of antiquated apparatus and of analytical methods long ago proven inadequate, yet still in use. It is with no small pleasure that we note that, somewhat late though it be, justice is done to Mr. Hartley in the matter of the calorimeter. For some reason there exists a prejudgment in favor of inventions when the inventor speaks a foreign vernacular which entices an American to use a French or, still better, a German instrument rather than an English one. Hence we enjoy seeing justice done in this matter to Mr. Hartley's memory. There is no longer any excuse for not knowing the part he really had in this important part of gas history; the study of it as a fuel, as a source of heat.

There are a number of things in the book which we would like to take up in detail; for example, the excellent chapter on the raw material, on coal. The warning, implicit if not explicit, that this important part of the subject requires more study may well be heeded in this country as well as in England.

The chapter on gas analysis also is worthy of attention, but if it be carefully examined the American expert will find much with which to join issue. Nor will the incorporation of Mr. Earnshaw's paper wholly satisfy the longing for more efficient means of working up the data obtainable by analysis. There is doubt but that Mr. Abady has set forth the *present practice*, as he has found it, but few will be found who will think that he has in any way advanced it. If the intention was to compile a book which should be the record of the routine practice of the last decade of the last century, then the book is a success; but if it was intended to advance the science, or the art, of the gas analyst, then the book has, it seems to us, distinctly fallen short of its writer's aimed at target. Twice, and carefully, have we examined the book, and nowhere have we found that thing never said before which seems to make a book a landmark in the development of an industry. The nearest approach to such a landmark is the chapter on the calorimeter and its use. Mr. Hartley, were he here, could not be otherwise than thankful for the worthiness of the shoulders on which his mantle has fallen.

But if the book does not advance the art and science it marks the passage of time. It sets forth the received practice of to-day in a way unequaled by any other book within reach of our arm, and the most part of the books worth having are within such reach; and with this book at hand one may well question if he needs any other one to show him just what the state of the art is to-day, just what the foundation is on which we are to build the art of to-morrow.

Considered in this respect, as a record of the state of gas analysis at the beginning of this century, the book is invaluable to the gas gas engineer and chemist, and even the general chemist can hardly afford to do without it; while the man who makes gas analysis his special work will find it easier to take this book as the foundation, and add the needed references to other books, making this his working manual than he will to reverse the process, and to reference this in the other books, so full is it of matter he must refer to.

The manner of the book is worthy of its matter. Paper, print and binding, all alike are such that the owner may well be proud of his purchase as a book, while to those who are familiar with its contents the fine dress seems but a worthy setting for the matter within.

NOTES.——

CAPTAIN OLIVER ELDRIDGE, for many years interested in a large way financially, in California Gas Companies, and at the time of his death Vice President of the Stockton (Cal.) Gas and Electric Company, died at his home in San Francisco, the night of December 16th. Deceased was in his 85th year, having been born in Yarmouth, Mass., August 12, 1818. In 1865 he went to the Pacific Coast, as Commander of the Pacific Mail Company's steamer "Commander," subsequently acting as the Company's agent in San Francisco for a year or more. He engaged in mercantile business on the Coast and amassed a fortune.

MESSRS. J. C. TUCKER, JR., S. T. Browning and E. C. Pierce, have applied to the authorities for the right to construct and maintain a gas works in the town of Narragansett, Rhode Island. The name of the concern is the South County Gas and Power Company.

MR. CHAS. H. NETTLETON, President of the New Haven (Conn.) Gas Light Company, returned about a fortnight ago from a short trip abroad.

ANOTHER returning voyager was Mr. Henry A. Carpenter, who says that the Riter-Conley Company proposes to construct in the near future in this country several large gasholders. They will put up at St. Louis another 4,000,000 vessel.

[Prepared for the JOURNAL.]

A Retrospect.

[By MR. FREDERIC EGNER.]

The incentive to this article was supplied by one of our most respected gas managers, who a few days since remarked to the writer: "All of the improvements which we have in the gas business seem to have come to us from abroad. We Americans seem progressive enough in everything else excepting the gas business; and in that we seem to be almost over-conservative. Do you not think so?"

Well, it does *seem* so. Yet appearances are somewhat misleading in that direction, as the writer could point out from the experience and achievements of the very gentleman that made those remarks, who most likely with his well-known modesty forgot to think of himself when speaking.

The charge of over-conservatism, however, is not without good grounds, neither is the statement concerning improvements in the gas industry without foundation; but we are not all alone on that road. "There are others." For example, while we are something like a dozen years or so behind Europe with the successful operation on a large scale of the inclined retort system for the manufacture of coal gas, our European colleagues are a good 15 years behind us in the introduction of water gas. But that is about the only instance where we can charge them with being somewhat slow, and for said tardiness they had some excellent reasons which we had not.

By chance, picking up a volume of the AMERICAN GAS LIGHT JOURNAL of just 20 years ago, the writer thought a retrospect at this time might be interesting and useful to your readers, and hence ventured upon this review, which he hopes may please and instruct—please those of the "Old Guard" who are left; and instruct (if possible) some of the younger generation.

Incidentally we may find that there is some reason for the conservatism of the American gas engineer; even an excuse if it is somewhat overdone. While it is regrettable that, with the immense capital invested in the gas industry, the importance of the same in the economics of life, no fund has yet been made available whereby sometimes very attractive theories could have been experimentally tried upon a scale large enough to settle for all time their utility or uselessness.

Let us take, to illustrate the last statement, an advertisement running through the whole of the volume before me, but which most of the readers of this JOURNAL probably have never seen.

First, there appears in large type the following:

"*Fogarty's Process of Manufacturing Gas.*"—Then follows a very well-drawn chart of chemical reactions, under which we read: "This process produces hydrogen gas free from carbonic oxide and simultaneously ammonia and bicarbonate of soda.

"It consists in: 1st, making a cheap heating gas through the action of steam and air on incandescent carbon; 2d, converting the nitrogen of the gas into ammonia; 3d, converting all the carbonic oxide in the gas into carbonic acid; 4th, purifying the gas from carbonic acid, without cost, by means of the ammonia produced; 5th, decomposing the bicarbonate of ammonia produced by means of common salt, producing chloride of ammonia and bicarbonate of soda.

"For information, address THOMAS B. FOGARTY, Room 25, No. 18 Wall street, New York city. P. O. Box 2,568."

Could anything in the gas line be more attractive than that? And yet, nothing ever came of it.

The inventor is, or at the writing of this article was, still alive and apparently struggling along—often in want, but still hopeful.

To the writer's personal knowledge, more money has been expended upon that alleged invention, in a desultory way with no tangible results, than would have sufficed to demonstrate the subject pro or con in a thoroughly satisfactory manner.

It is still a live issue. Millions upon millions of dollars have been freely given for the establishment of libraries, which, although very worthy in their way, are not and cannot be a tithe as important to mankind in general upon the whole globe as this invention, in the bringing out of which more than five score of the scientists of the past century have labored more or less; mostly less, because the cost to try was greater than any individual of them could afford. Some went deeper than others into the subject, and we are getting closer and closer to its solution.

The writer himsrlf has studied the work of no less than 107 persons, some of great note, who have worked upon it, among them that of Mr. Fogarty, who probably got nearer to the solution than anybody else.

That this subject is not only of great importance to the gas industry,

could it be made a commercial possibility, but to the whole of mankind, would not be at all difficult to prove to any intelligent person; and yet, as above stated, no fund was ever available by means of which the question could have been either solved or disproved for all time, which in itself would have deserved consideration, since it would have, so-to-speak, laid a ghost which may yet trouble some of you.

So here is an issue of 20 years ago which is still to be finally disposed of. Not so with another.

Again taking up the advertising columns of the JOURNAL of 20 years ago, we find one reading as follows:

"*Circular to Gas Light Companies.*—Branch office of the Strong Gas, Fuel and Light Company, corner Broadway and Main street, Yonkers, July 2d, 1881.

"The Yonkers Fuel Gas Company is now in successful operation, manufacturing water gas by the Strong Process, for heat, power and light.

"It has about 2½ miles of mains already in use through the heart of the city of Yonkers, and is supplying gas for cooking, heating and various industrial purposes.

"The problem of a purely fuel gas is at length practically solved, and is a complete success. That it must speedily go into universal use is apparent to everyone.

"Gas light companies are cordially invited to visit Yonkers and inspect this new system, which, if electricity *should* eventually drive them out of the field of illumination, will open to them another field still more vast and fruitful, and from which they never can be dispossessed.

"The Westchester Gas Light Company, of the city of Yonkers, employs the Lowe process for making its gas.

"Here, then, can be seen, side by side in business competition, the Strong and the Lowe against the Motay and the old coal gas methods, and each observer will be enabled to form his own opinion as to their relative power and value.

"The Strong Gas, Fuel and Light Company is the proprietor for the State of New York of the Strong patents, five in number, and of the Lowe patents, two in number.

"All applications for license or for information should be addressed, as above, to R. W. VAN PELT, President of the Company, and also President of the Yonkers Fuel Gas Company, and the Westchester Gas Light Company."

The reader will observe with what force it is stated that the problem of a purely fuel gas was "at length practically solved," etc. How many of you now remember what the Strong process really was? Evidently, according to the law of "The survival of the fittest" it was "Not in it" with the Lowe process. And for all that many thousands of dollars were both made and lost in it; enough at any rate to contribute to the conservatism of those whom it concerned probably.

But this was in the days when water gas promoters had still to fight their way; and not infrequently were dubbed "Pirates." A good many men still living thought that the appellation was deserved, too; but at this date they are all making water gas, and glad they have at last found out about it.

It would no doubt have been better to have found out about it sooner, before condemning the process bitterly, and finally after, in some instances spending many thousands of dollars to fight something not well understood, be at last obliged to "eat crow" and be glad in the light of latter days that we did it.

But a lesson for the future might be drawn from the real experiences of the past, the almost immediate past at that, for 20 years is after all not such a great while.

Some good things went to pot also; for just under the last quoted advertisement, we find one of Chas. F. Dieterich's regenerator furnaces which could be "adapted to any bench." This was really a good furnace, and could be applied as advertised with a certain saving to the applicant. But the very works where this furnace was, as advertised, in successful operation, viz., the Peoples Gas Company, Baltimore, Md., is no longer in existence, excepting the purifying house, exhauster and meter rooms. The retort house is a roofless ruin, melancholy to behold to an old retort house man, while the two gasholders once there were obligingly removed by successive tornadoes some years since, and only the brick tanks now remain.

The inventor of that furnace, and also of a number of other useful things, has made his millions since then; but very likely not any part of them by means of his very good retort bench furnace, which is only seen now by a close imitation under another name.

Observant readers may have noticed the fact that the gas business supplies a fairly good barometer by which to estimate in general the prosperity of our country; and in like manner the advertising columns of the JOURNAL will be found a pretty good criterion from which the progress of the industry in a technical sense may be estimated.

Let us look over some of the advertisements appearing in the number of the AMERICAN GAS LIGHT JOURNAL for January 2d, 1883; or, more correctly speaking, No. I., Volume XXXVIII.

Here we find an advertisement of the "Standard Washer Scrubber, Kirkham, Hulett and Chandler's Patent," the best machine for the extraction of ammonia which had been devised to that date, and which is, while improved upon, only imitated by later designs, and the best still.

In that advertisement we are told that in all 123 gas companies had applied this excellent apparatus; but among them only 12 American ones, viz., Columbus, O.; Citizens, of Newark, N. J.; Consolidated, of Baltimore; Equitable, of the same city; Metropolitan, of New York City; Newport, of R. I.; Providence, R. I.; Richmond, Indiana, St. Joseph, Mo., and the Williamsburgh Company, of Williamsburg or Brooklyn, E. D.

The advertiser, the late Geo. Shepard Page, states that "the concentrated ammoniacal liquor produced has an immediate sale at prices much above what has heretofore been offered, or can be converted into sulphate of ammonia, with large profits, by the use of the Kirkham-Page sulphate apparatus, estimates for which will be given gas companies."

Poor George Shepard Page! He was a welcome visitor at every one of our gas Associations at that time. His sad end was mourned by the many who knew him.

Upon one of the pages we find, in peaceful company, the "ads." of our friends of the "mud business," as they among themselves speak of it.

The "Chicago," and the "Cincinnati" Gas Retort and Firebrick Company, as also Evans & Howard, of St. Louis, are not found in the JOURNAL of the present date. The old, reliable Baltimore Retort and Firebrick Company, though doing business in the past, does not appear in the advertising columns of 20 years ago; but in place of those that have dropped out, we now find the very lively Missouri Firebrick Company, of St. Louis, Mo., and the Parker-Russell Mining and Manufacturing Company, of the same city.

All the rest are still with us, howbeit the sons have taken up and continue the work so well and creditably begun and honorably carried on so long by their worthy fathers. May they flourish, and at the end of the chapter be found with their spotless reputation and goodwill left them by their forebears; though one thing these all with great unanimity claimed—especially about the time things warmed up at the annual banquet or so—namely, that they (in confidence and on the quiet) were certainly *the first* to introduce fireclay retorts in this country.

Oh, yes! They all did it. Our dear old friend, Adam Weber, who introduced them from Germany; and Col. James (jovial, good old "Jim.") Green, who brought them direct from Stourbridge, in England; and Gautier; Borgner & O'Brien, who brought them from Ireland, no doubt; Gardner (of respected memory), and all the rest who brought them from parts not disclosed, but nevertheless were all of them *the first*, just as good as the rest of them according to their own stories, which nobody at such a time was ill-natured enough to doubt. The boys cannot do *that;* they might do something equally as well, if they would find out "a mix" of clay which would give reliably and beyond question the best results in the dry dislillation of coal to the gas maker. That is, put such material into the retorts as would give the greatest durability, together with best conductivity of heat.

On the same page with the announcements of the fireclay men we will find the "Pelouze & Audouin Condenser," with "Smedberg's Improvements." The "P. & A. Condenser" is *guaranteed to arrest every drop of coal tar.* And, so the advertiser (Jas. R. Smedberg) stated, "May fairly be considered a standard and indispensable." Furthermore, "During the 8 years which have elapsed since its introduction, it has been adopted in the following gas works." And here are given the names of 22 works, not one of them being that of a leading gas company, but only, for example, the Napa Insane Asylum, Ohio Penitentiary, Hotel del Monte; but, stop; yes, here we have also San Francisco, New Orleans, and the Municipal works of New York city named; and this, in connection with an apparatus which the writer, from years of personal experience with it, can assert to be all that was claimed for it. Not only that, but the best apparatus in every respect to accomplish its object that was ever, up to the present date, devised. Only careless or ignorant handling could make it fail to perfectly do its work.

Perhaps here you may find in these few words ample confirmation of the charge of over conservatism of the American gas engineer. The writer considers it as deserving a more fitting name, but because of re-

cent good Christmas cheer, will refrain and omit the more bitter, though fitting appellation such a neglect, as that poor advertisements' brings home to some of us deserves.

"Iron Sponge" will also be found advertised in the number of the JOURNAL named. It is, as all know, still with us, under the guidance of genial "Governor" Hayward, and who now has associated with him, our ever bright friend, Geo. G. Ramsdell, who 20 years ago was better known as "from Vincennes," but since then has "Passed through the chairs" of both the Western and American Gas Associations, and has not yet graduated to "the committee on final resolutions," but still is sought for as a member of "The Committee on President's Address" when gas men meet, and he is present.

The P. H. & F. M. Roots' Exhauster Company is with us yet, only that the machine has been somewhat improved, while the "old folks" who conducted its manufacture, and early introduction, notably among them dear, old friend Townsend, have gone to their rest years ago.

The Mackenzie exhauster, shown in a nice illustration in this somewhat faded number of the JOURNAL, is now made by the "Isbell-Porter Company," then known as the Smith & Sayre Manufacturing Company —then as now, of 245 Broadway, New York. Only "Charlie" Isbell is left of the original firm; but he is as bright as ever, and has only during the past year been granted a number of patents for a *real* "vertical retort" system, which to the writer seems to have much to recommend it to the practical gas man, and may be heard of later on.

Messrs. Bartlett, Hayward & Company are seen in a small 3-inch "ad.," whereas their evident prosperity and progress through the past score of years is now marked by nearly a full page; and R. D. Wood and Company, the Continental Iron Works, the Kerr-Murray Manufacturing Company, the Stacey Manufacturing Company, and Deily & Fowler, who proudly let you know at this date that they have been in business for 50 years, may all be found at their old stands.

Some have dropped out. For instance, Morris Tasker & Company, and the once, old and reliable "Oregon Foundry" of Herring and Floyd; much regretted by everybody that knew them; while their loss has been more than made up by new firms which in some instances are represented by the conductors of those who have gone out of business. We have the Quintard Iron Works, for example, "Frederick W. Floyd, Engineer," in place of one of these.

Then amongst the prominent new comers are the names of Christopher Cunningham and the Logan Iron Works. And so it is with quite a number of individuals and firms then not known, now leading in various specialties. Indeed, the advertising columns embrace much that is instructive in all of our gas journals, and from all of which we may learn much concerning the progress of our industry during the past two decades; and it might be well for the rising generation to know that by looking over the old files of the JOURNAL they could often be saved a heap of trouble, and occasionally learn that there was not nearly as much of the "new" under the sun, as they may fondly or perhaps even proudly think. The writer was in the same boat 30 years ago, and speaks from experience. Seriously speaking, it will be found that there are quite a number of very good ideas and things, which were known long ago and successfully applied, but have somehow got lost in the hurry of modern days, which would save time, trouble and expense to know, all of which could be accomplished by a little reading of what the pioneers in the business had done. It may be truly said here, too, that "There were giants in those days," especially when it should be remembered that they had no material to draw on such as is now so plentiful; and with that should come the thought that experience is after all not to be despised, though it is not considered of much value by those who know no better is a sad fact of present day wisdom in the management of many gas properties.

"King's Treatise on Coal Gas" is still the standard work of the present day on that subject, so that one may get to thinking that while we certainly have advanced, the progress has not been enough to worry one much, who *thoroughly* knew his business 'way back 20 years ago, and who may have kept up with the procession since.

Of the meter makers, we find nearly everyone of the present date represented in the past, excepting that of our dear, lamented brother, Wm. Wallace Goodwin.

Mr. Goodwin did more for the advancement of gas for domestic purposes (cooking and heating) than all the rest of the gas fraternity together.

The writer is to-day building this article in a room heated by a gas heater made 20 years ago, which is still not only in good order, but unsurpassed in effectiveness as well as economical sensible application of gas by any more modern stove made. "Cookers" *have been* improved somewhat in detail of construction, but nothing else, since Mr. Goodwin gave his lectures on cooking by gas, which are worth reproduction intoto, and would benefit gas companies to-day, if liberally distributed to consumers.

But enough of the advertising columns; let us glance over the literary portion of our relic.

We shall find the "Seventh Annual Meeting of the Society of Gas Lighting" *reported*. Of the officers of that day, none are now in the gas business, and nearly everyone has laid down the load, respected and mourned even to this day by those who were so fortunate as to know them.

Jos. R. Thomas, C. V. Smith and G. Warren Dresser are dead, but J. H. Armington and Eugene Vanderpool survive. As for the Society, it still flourishes, but like some of lesser note, it has fallen into quiet ways apparently, for its proceedings, as valuable as ever, are no longer reported or published by the AMERICAN or any other GAS LIGHT JOURNAL. Its light is no longer for the general good, but has become very exclusive for many years.

The same can be said of the American Gas Light Association, whose "Tenth Annual Meeting, held at the Monongahela House, Pittsburg, Pa.," is reported in this volume.

The Association named, some years since, decided to no longer permit the technical press to publish the proceedings verbatim, but yet they voted their funds, and to a considerable amount, to maintain a free correspondence school for the education of budding genius, with the ambition some day to become, maybe, gas superintendents.

And in and out of the Association that object has been strenuously urged, while the plain, simple fact that the publication of the proceedings in the JOURNALS would be one of the best conceivable educators of those *who would take enough trouble merely to read them*, seems never to have occurred to the wiseacres at all.

These publications did not cost the Association one cent at any time. Every member taking part in the proceedings would see at the earliest possible moment if he had been correctly quoted, could correct and be corrected, and by an intelligent correspondence, such as we may find in the very volume herein discussed, add greatly to the dissemination of knowledge.

If we are going to spread our information in a professional sense, freely and broadcast, then why hinder the free publication of our proceedings?

Among those who took part in the discussions of that meeting we find some familiar names, names of men who up to date have always done their share towards increasing knowledge, and who have given theirs freely for the benefit of all. Let me quote: Greenough, Nettleton, Forstall, Sr., Harbison, Slater, Sr., H. H. Edgerton, who contributed an even now most interesting paper on "Heating by Gas," to which Mr. Goodwin added not a little with valuable information, which he seemed, so-to-speak, to carry at his fingers' ends.

Further along in the volume we find the "Official Report of the Western Gas Association." It had then its sixth annual meeting, which was held May 9th, 10th and 11th, 1883, at the Burnett House, Cincinnati, O. Our old friend, "Uncle" Jerry Howard, presided, and delivered an address full of good, sensible things, though notably shorter than is now customary to stretch the annual presidential lecture. Forty-eight members responded to the roll call, and 49 new members were added to the list.

Here, indeed, we may note progress with emphasis, when we consider that at the last regular meeting of that Association there were on the rolls 12 Honorary, 283 Active and 78 Associate Members, or 378 in all.

That Association has always been true to the high standard of the object, set up by the original few who organized it, at the office of the former St. Louis (Mo.) Company.

No star chamber methods ever had a show with "The Western," and its proceedings are freely published to the world at large. And those who have read know that the matter presented by members of that, and to that Association, has ever been equal to the best standards of any other.

Another gas association mentioned in this volume, viz., the "Central New York Gas Engineers' Association," which came to its fourth annual meeting, has passed out of existence.

Few State Gas Associations had the vitality of that very bright, lively one, "The Ohio Gas Association" of to-day, but which was not yet then born, which is additional proof that we have progressed remarkably in some things in as great a measure as we have stood still in others.

With this, I will close the "Retrospect," hoping it has awakened pleasant memories with some and unkind thoughts with none. The text is so rich in matter that this review could easily be spread over double the space allotted to it; but would it be desirable? The writer cannot tell, but does hope that the present effort shall meet with the same kind reception as the time and season permit.

Address of the President (Mr. W. G. Seabury) of the Kansas Gas, Water and Electric Light Association, Delivered on the Occasion of Its Fifth Annual Meeting.

Gentlemen: The Association is to be congratulated that this, its fifth annual meeting, is assembled under so favorable auspices. Neither death nor any special misfortune has invaded our ranks, and we find ourselves affected only by the ordinary changes incident to the active, pushing life common to this country, in which every man is on the alert for something better. Some have sought the better thing in a change of location, leaving us without their assistance, others have joined us, thus finding the better thing (which we trust will never be taken from them), and also maintaining the number of our membership.

While both material and labor continue too high to warrant the undertaking of more than necessary improvement and extension, and while we are greatly handicapped by being unable to adjust our prices to a considerably increased cost of production, yet the larger average income of most of the consumers of light and water, added to the amount of money available on loan, stimulating building, have caused a sufficiently increased volume of business, that we are justified in saying that the past year has been one of prosperity.

The persistent clamor for lower rates, prevalent some years ago, and which seemed to be directed more particularly against the gas companies, has generally subsided, and while dollar gas can hardly be regarded as the exception, those companies that successfully resisted very strong pressure and maintained their rates, are able to continue them, to the apparent satisfaction of their patrons. It is not impossible that the people in some measure realize the situation and are willing to concede that prices which were regarded as excessive in the past, are now under changed conditions quite reasonable. The speaker is one of those (perhaps too numerous) individuals who believe that the average American citizen is endowed with a large share of the spirit of justice and fair play—these people seem to be showing that they have some comprehension of their tremendous power and are learning how to use it; it may be wiser to conciliate than to antagonize them.

The gas engine is slowly, perhaps surely, making a record for itself in the industrial world. The installation of at least one pumping plant, with power derived from a gas engine, is some indication of possibilities; and though there is some contention that satisfactory results could not be obtained outside the natural gas fields, and though it is probably true that three-quarters the gas engines in use are in such localities, yet very strong claim is made that the energy in a pound of coal may be transformed to useful power in larger measure and more economically through the medium of the gas engine than the steam boiler.

The subject of gas leakage is attracting notice, not only from the standpoint of distribution and returns at the gas office, but from a sanitary point of view by boards of health, and as a menace by insurance companies. Chemical tests recently made "have established in living and sleeping rooms the presence of illuminating gas in dangerous quantities, in the inodorous form in which gas filtered through the soil is commonly found in buildings to which main leakage has access. To the presence of this gas is ascribed the prevalence of low fevers resembling those called malarial." A large number of mysterious fires are credited to this gas, as well as no inconsiderable portion of the death rate. In testing for this gas something more reliable than the nose of the gas man is necessary. That too early in its career becomes immune. In the matter of a cheap and satisfactory light the gas companies do not seem inclined to be left in shadow, but persist in pressing the electric people rather closely.

Electrolysis continues to be a subject of interest and anxiety. As yet there has been but little success in cheaply controlling its destructive tendencies. So far as there have been legal decisions they have not been of a nature to give encouragement to companies operating pipe lines. The trolley lines have come to be regarded as of almost as much importance as light and water plants. Transportation is hardly less necessary than light and water. Some way must be found to provide the new one without destroying the others.

The introduction from time to time of new and presumably improved lamps is evidence that the electric companies are earnestly seeking and constantly making progress. The attention given to electric heating is apparently slight; yet the last census shows that the sale of apparatus devoted to this branch of electricity amounted, in 1900, to nearly one and a quarter million dollars; for the past year the figures could probably be increased considerably, showing an advance in this industry. That there are fields as yet wholly untouched, awaiting the profitable cultivation of the thrifty electric husbandman, is evident from the following incident given in a recent publication:

"A certain Pennsylvania truck farmer had been remarkably successful in the early marketing, and in the fine quality of the vegetables he produced, exciting the envy of his less fortunate neighbors. At the same time the officials of the trolley company began to notice that a very large amount of electricity was consumed in the operation of its lighting business and the moving of its cars. By strange coincidence it is said that the greater the prosperity of the farmer, the more alarming became the trouble of the electric company. The situation at last became so desperate that it was found necessary to call in the assistance of men of science to solve the mystery. One of these men quite accidentally heard of the marvellously fine crops raised by the truck producer. He made an investigation and found, it is alleged, that the trolley feed wire had been ingeniously tapped, and that a fine net work of wires ran through the soil of the truck farm," thus accounting for the tribulations of the company, the growth and prosperity of the farmer, leaving imagination to inflict the inevitable penalty for wrong doing that is discovered. As this incident did not occur in Kansas we, therefore, cannot vouch for the truth; but it well illustrates the obvious fact that the electric companies have by no means reached the limit of their opportunities!

In pumping water we are largely confined to long established methods. With perhaps a single exception of a gas engine used as power an occasional experiment (more or less successful) with compressed air, the hardly more than mention of a propeller pump, a suggestion of rotary pumping, the old methods largely obtain. Effort is mostly confined as heretofore to the matter of purification. The important matter of economic distribution receives but little attention. It can hardly be credited that an Association, having been in existence for more than 5 years, consisting in part of water works men, has never had presented for its consideration a paper on the use of the meter. The testimony of superintendents is universally in favor of the use of the meter; but their influence on the public mind is not observable. There is perhaps no section of the country in which this subject is receiving less attention than in our own progressive State. If the matter of water works operation is open to criticism it is not in the way of inadequate supply, insufficient pressure, or unsatisfactory quality, but over-abundant distribution, excessive waste. With a daily per capita of from 10 to 50 gallons in English cities, against 75 to 200 in American cities, there would certainly seem to be a wide margin for waste; but even here there is a chance for argument. A friend of the Englishmen, writing on quite a different subject, says: "The English are always boasting that they are a cleanly people, and no doubt the upper class Englishman does spend an inordinate amount of time in cleaning himself; but the average Englishman, with his woolen shirts, which are only washed in tepid water; his clothes, which are never washed at all; his carpets, which retain the dust of years; his stuffy, woolen covered furniture which lasts for generations, and with his beds which are hardly ever properly cleaned, is by no means the cleanly animal he thinks himself.

And yet it is generally admitted that the bane of water companies is waste. The hearts of anxious superintendents, engineers and sweltering, grimy firemen (to say nothing of officers and stockholders) grow sick at the increasing volume of wasting water. With plants located contiguous to some limitless supply, it is but a question of machinery of adequate capacity, but to a large number of stations it is a matter of reaching the limit and asking a not too willing public for quarter.

It is quite unnecessary to call your attention to the extent and variety of our programme. You anticipate pleasure and profit. If the gentlemen who have promised contributions do not disappoint us as well as themselves in some inability to be present, I feel assured your anticipations will be more than realized.

The Future of Coal Gas and Allied Illuminants.—No. III.

[The Third of a series of Cantor Lectures, delivered before the Society of Arts, London, England, by PROF. VIVIAN B. LEWES.]

The alterations which are taking place in the conditions under which coal gas may be used for illuminating purposes are so entirely dependent upon the adoption of the incandescent mantle as a means of developing light that one of the most important questions to be discussed must, of necessity, be the relation existing between illuminating power, calorific value, and the light that can be evoked from the gas when burnt in an atmospheric burner by means of the incandescent mantle. At first sight there seems to be a wide discrepancy between observers on this point, and the literature of the past 2 or 3 years leaves one with a feeling of hazy uncertainty as to what relation really exists between the character of the coal gas and the light which the mantle will emit from it.

Herr W. von Oechelhaeuser came to the conclusion, from experi-

ments made upon the Dessau gas, that a reduction in the illuminating power of the gas causes an increase and not a decrease in the candle power of the Welsbach light. These experiments we will discuss later on. Some time later, Dr. Bunte read a paper before the International Gas Congress in Paris, in which he pointed out that the changes in composition of gas which reduce the illuminating power in flat flame and Argand burners to a very great extent have but little effect in producing differences in the illuminating duty of the Welsbach burner, and he showed by photometric measurements that the gas supplied in Berlin, Charlottenburg, Dessau and Karlsruhe, although varying in illuminating value from 7.7 candles up to 10.9 candles, gave, in spite of this relatively wide divergence in illuminating value, no difference in the light obtained from the mantles. He also showed that the calorific values of these gases were very nearly equal. A series of papers by Messrs. White, Russell and Travers, in America, give the results of a research on the incandescent mantle and its behavior, and they came to the conclusion that the light emitted by the mantle has little or no relation to the illuminating power of the gas when burnt *per se* as a luminous flame, and will increase almost directly with the net calorific value, the increase being at the rate of 1 candle per cubic foot for every 4 calories increase in the net heating value.

I especially notice these three sets of observations, as in each case the work was carried out apparently with the necessary precautions that should be taken in securing accurate results. But there have also been a large number of experimental determinations made in which neglect of such important factors as the regulation of the air supply in the burner and the initial gas pressure have led to still more chaotic results. In order to fully grasp this most important side of the question, and to satisfactorily determine the real effect produced, it is necessary to consider the factors which govern the atmospheric burner and produce from coal gas the non-luminous flame which heats our mantle.

In a lecture on the theory of the atmospheric burner, which I gave before the Incorporated Gas Institute in 1897, I pointed out that the portion of the Bunsen flame which heated the mantle, no matter what the composition of the original coal gas and the amount of hydrocarbons which it contained, if the burner were properly regulated as regards the air supply, consisted, as far as the combustible constituents went, of carbon monoxide and hydrogen; so that, leaving out of the question the initial heat given by the incomplete combustion in the inner zone, water gas burnt without any admixture of air would prove a highly successful method of developing light from the mantle.

The chemical changes taking place in the flame of the atmospheric burner were first studied by Blochmann, whilst Professor Smithells and I have of late years done considerable work on the subject. The actions taking place are perfectly clear. An ordinary 16-candle coal gas requires from 5.5 to 6 times its own volume of air for its complete combustion. If about half this volume of air is caused to mix with the gas before ignition at the burner head, the gas is consumed in two stages, which gives the dual character to the flame, the inner zone being produced by incomplete combustion at the expense of the previously admixed air, whilst the outer zone is due to the combustion of the products of incomplete combustion from the inner zone, which takes place at the expense of the oxygen from the outer air.

Such a flame, however, is not the best that can be employed for heating the incandescent mantle. If the air supply be further increased, the inner zone, in which the primary combustion is going on, shrinks in size and becomes green in color, and in an ordinary atmospheric burner, such as is used in laboratories, any further increase in the air supply before combustion causes the flame to flash back to the bottom of the burner. But with various forms of burners for incandescent mantle heating arrangements are made which prevent this, and the quantity of air can be still further increased. The popular idea of such burners as the Kern is that practically the whole of the air needed for the combustion is mixed with the gas before it burns at the burner top. This, however, is an entire mistake; and if such a result could be obtained it would defeat its own purpose.

The best result is obtained from the incandescent mantle when a little over three-quarters of the requisite quantity of air is mixed with the gas. This gives an inner zone of a bright green, which appears to seethe and boil on the gauze top of the mantle burner, whilst the products of incomplete combustion escaping upwards from this zone consist of:

Water vapor	16
Nitrogen	60
Carbon monoxide	9
Hydrogen	10
Carbon dioxide	5
	100

It is this mixture, escaping red hot from the inner zone, which, in its combination with the oxygen of the outer air, excites the mantle to incandescence. If the aeration of the gas before burning is pushed beyond this point the candle power yielded by the mantle falls, instead of rising.

Various theories have been put forward to explain the wonderful light emissivity of the incandescent mantle, the latest one being that of Messrs. White, Russell and Travers, who conclude that the oxide of cerium is held in a state of solid solution by the oxide of thorium, and that this exerts a specific influence in altering wave lengths, so that the mantle emits more blue and green rays and fewer red rays, *i.e.*, converts more of the energy of the flame into light and less into heat than does the ordinary flame that owes its incandescence to carbon particles. For my own part I do not agree with this, and am in entire accord with the theory of Professor Bunte, that the process of combustion and the heat given thereby are stimulated by the catalytic action of the material of the mantle; and I consider that Luggin's experiment, which showed that the Welsbach material can be brought by catalytic action in a cold mixture of gas and air to a state of full luminescence, to be conclusive evidence on this point.

Taking these factors with regard to the condition of combustion as existing in the atmospheric burner flame, it is evident that the calorific value of the original gas will exert a certain influence on the temperature of the inner zone of the flame, and that the superheating action of this upon the combustible constituents of the escaping gas and the escaping products of combustion will influence the temperature existing on and close to the surface of the mantle; so that, supposing the burner to be working under the best conditions of air supply, the light emitted will follow the calorific value of the gas. But the difference between the illuminating values given will only be a very small proportion of the difference between the calorific values of the two sample of gas.

I showed in 1900 that the effect of the superheating influence of the inner zone upon the outer portion of the flame is clearly demonstrated by using a Smithell's tube, by which the outer and inner zones of an atmospheric flame can be widely separated. Under these conditions the superheating effect of the inner zone is reduced to a minimum; and a mantle heated in the outer zone gives but a poor light, whilst on allowing the inner zone to rise in the tube the luminosity of the mantle increases, until, when it has resumed its normal position in the centre of the flame, the mantle emits its full light. It is clear from this that the superheating by the inner zone plays a part in the light emitted by the mantle. But in all the experiments I have made with gases of varying illuminating and calorific values I have failed to find any alteration in the light yielded by the mantle that would justify the adoption of such a ratio of decrease as that given by Messrs. White, Russell and Travers, *i.e.*, 1 candle per cubic foot for a diminution of 4 calories, and I am forced to the conclusion, from my own experiments, that for calorific values such as mixed gases between 12 and 18-candle power possess, with proper air adjustment to the burner, the loss of light given by the mantle is so small as to be far overshadowed by the alterations in light due to inequality of shape in the mantle and other factors, apart from the calorific value of the gas.

The record of one experiment will show what I mean. A good mantle on a "C" burner was tested with a 17.7-candle power gas and gave 20.6 candles per cubic foot of gas. Forty volumes of blue water gas were then added to 100 of the coal gas, and time given to complete the mixing of the two gases; and on again testing, under precisely the same conditions as before, the mantle gave 17.7 candles per cubic foot of gas, and the light became a little unsteady. A collar was then fitted to the air holes of the burner, and on regulating the air supply until the mantle gave the best results, a light of 20.1 candles per cubic foot was obtained. The details of the experiment are:

Gas.	Illuminating Power. Candles at 5 Cubic Feet Rate.	Illuminating Power. Candles by 16 Candle Rate.	Calorific Value in Calories. Gross.	Calorific Value in Calories. Net.	Candle Power in Mantle per Cubic Foot. Air Ordinary.	Candle Power in Mantle per Cubic Foot. Air Adjusted.
Coal gas.....	17.7	17.6	172	155.3	20.6	20.6
Coal + water gas (100 + 40).....	11.5	14.0	136	121.8	17.7	20.1

The pressure was 1½ inches in each case, and the gas was burnt at the same rate of flow, *i.e.*, 4 cubic feet per hour, in both experiments.

It is seen in this case that the loss of light given by the mantle was half a candle for a loss of flame illuminating value of 6.2 candles, if tested by the 5 cubic feet rate, or 3.6 candles if tested in a rational manner. There was, moreover, a loss of calorific value in the gas equal to 33.5 calories. Therefore, according to the ratio given by Messrs. White, Russell and Travers, the 20.6 candles per cubic foot

ought to have been reduced by $\frac{33.5}{4}$, or 8.3 candles, so that 12.3 and not 20.1 candles should have been found. It is clear, therefore, that if care be only taken to properly adjust the burners, air supply and mantles to the gas supply of a district, which could easily be done, the differences due to the lowering of the candle and calorific values of the gas become so small as to be negligible.

To my mind this is a convincing proof of the truth of Dr. Bunte's catalytic theory of incandescence. If the light emitted by the mantle be due not so much to the temperature of the flame as to innumerable points of high temperature created on the surface of the mantle by the catalytic action of the ceria upon the hydrogen and carbon monoxide, when once the temperature necessary to carry this on in the best way is reached, then the rise in temperature due to the combustion of a gas of high calorific value in the inner zone of the flame would merely increase the glow due to the effect of the slight extra heat on the mantle fabric. How small this is can be judged from the light emitted by a pure thoria mantle heated by the combustion of different grades of gas, and experiment shows that this is about the difference found in the experiment recorded with the 17.7 and 14-candle gases.

The results upon which Messrs. White, Russell and Travers based their views on the effect of the calorific value of the gas on the mantle may be arranged in order in the following table, interpolating the value in B.T.U.'s as well as calories:

Comparison of the Heating Power of Gases with the Light Given by the Incandescent Mantle.

Calories (net) Per Cubic Foot.	B.T.U.'s Per Cubic Foot.	Pressure in Tenths.	Gas Burnt Per Hour. Cubic Feet.	Total Candle Power.	Candles Per Cubic Foot.
60.24	240.96	22	7.58	41.92	5.53
62.39	249.50	20	7.20	69.63	9.67
67.03	268.12	20	4.93	27.13	5.54
108.90	235.60	20	5.20	91.00	17.50
112.11	448.44	20	4.95	102.95	20.69
130.90	523.60	20	3.56	77.83	21.86
140.55	562.20	20	3.45	87.04	25.60
144.30	577.20	20	3.25	82.65	25.40
147.86	591.44	21	3.40	96.67	28.48
153.83	615.32	20	3.50	95.91	27.40
156.10	624.40	21	3.10	92.24	29.75
162.96	651.84	20	3.00	96.30	25.43
169.60	678.40	20	3.15	103.73	32.90
219.28	877.12	20	2.05	45.90	22.94
239.38	957.52	20	1.80	74.96	41.63

The gas that heads the list with 60.24 calories net is blue water gas, and they find that under the conditions of testing they employed it gave with the mantles 5.53 candles per cubic foot. But with a burner adapted for the consumption of water gas I have obtained the following results:

Blue Water Gas Burnt in Argand Burner with Welsbach Mantle.

Pressure in Tenths.	Gas Consumed. Cubic Feet.	Illuminating Power. Candles.	Candles per Cubic Foot.
5	6.2	120	19.3
8	7.0	137	19.8
11	8.0	145	18.1
12	8.5	145	17

The fact of 5.53 candles being put forward as what may be expected from blue water gas under the best conditions of burning makes one feel disinclined to put any great degree of confidence in Messrs. White, Russell and Travers' results, which are manifestly wrong.

A point which cannot be too strongly insisted upon is that the mesh of the mantle and the size of the opening at the top are important factors in the light emitted by different grades of gas, and should be attended to with the same care as the degree of aeration. Experiments soon show that the mantle best fitted for use with a rich carburetted water gas, such as is used in America, would give very poor results with a 10 or 12-candle gas, whilst the gas injector nipple suited to a rich gas is useless with a low grade gas. It may be neglect of such conditions as these that has led to such manifestly erroneous deductions.

The result of Herr Oechelhaeuser's experiment with Dessau gas, which showed that a reduction in candle power, as tested with a batswing burner, of from 13 to less than 2 candles caused an increase from 66.5 to 73.5 candles with the Welsbach mantle, may have been partly due to the conditions of air supply to the burner being better fitted for the combustion of the lower grade of gas; but there is another factor that must not be lost sight of, as it has an important bearing on the use of blue water gas as a diluent for coal gas. It is well known that the increase in volume of hydrogen and carbon monoxide caused by diluting coal gas with blue water gas shortens the flame and increases the intensity, and in this way makes the light of the flame whiter, due to the higher incandescence of the carbon particles. With the incandescent mantle the same thing is noticeable, and I have many times obtained the same result as Herr Oechelhaeuser. In the case of the Dessau gas the lowering in candle power was brought about by "stripping," *i. e.*, removing absorbable hydrocarbons, and this would have the same effect, as it increased the percentage of hydrogen present, and either this gas or carbon monoxide have the same shortening effect on the flame as the mixture of the two (water gas).

An even more accentuated case of the same character came under my notice last year. I was testing the gas in a northern town, and found that in the standard flat flame burner it gave an illuminating value of 20 candles. The gas was made from coal, and had an illuminating value of 13 to 14 candles before enrichment; and it was brought up to 20-candle gas by benzol vapor. I was struck by the poor light given by the mixture in the incandescent lamps of the town, and on testing it with mantles burnt both at the ordinary "C" and Kern burners (No. 4) could only get a total illuminating value of 46 to 50 candles. I then tested the unenriched gas, which at that time had an illuminating value in the London Argand of 14.11 candles, with the same mantles and burners as before, and got 80 to 90 candles without any trouble. The 20-candle benzolized gas had a calorific value of 608.8 B.T.U.'s net; the 14.1-candle coal gas 510 B.T.U.'s.

I could only assume that benzolized coal gas was unfitted for use with incandescent burners with ordinary adjustments. I repeated the experiment with the Kern burner, carefully measuring the rate of flow, and also trying the same coal gas enriched with petroleum spirit to 21.5-candle power.

Kern Burner (No. 4) with Mantle.

Enricher.	Illuminating Value of Gas. Candles.	Pressure in Tenths.	Rate of Flow. Cubic Feet.	Illuminating Value. Candles.	Candles per Cubic Foot of Gas.
Petroleum spirit ..	21.5	15	3.20	34	10.6
Benzol.....	20.0	15	3.45	46	13.3
None	14.1	15	4.45	90	20.2

In all probability the explanation of these results is to be found in the fact that although the air holes of the burners were full open they had been made for a 16-candle coal gas, and gave too small an aeration for the enriched mixtures, and that if the nipples of the gas injectors had been changed more normal results would have been obtained with the rich gas. I give these results, not as showing that enrichment reduces the lighting value that can be obtained from a mantle, but rather as showing that the consumer is more likely to get his money's worth with a poor gas than with a doctored-up high candle value gas, as in 9 cases out of 10 the burner vendors never take the trouble to adjust the burners to the quality of gas with which they are to be used.

Another question which is an important one is the effect of the pressure under which the gas is supplied to the burner upon the light emitted by the mantle. When the pressure of the gas rises, the visible effect is an increase of light from the mantle. But within the ordinary limits of gas supply, *i. e.*, between 1 and 4 inches pressure, this increase is more apparent than real. Mr. Walter Grafton last year read a most interesting paper before the Gas Institute on the effect of quality and pressure on the efficiency of incandescent gas lighting, and gave a table of the results obtained with various grades of coal gas and coal gas enriched by carburetted water gas, as well as a number of results obtained from mixtures of these gases with air. Taking his results for the coal gas and enriched gas only, and calculating the results at 1, 2 and 3 inches pressure to candles per cubic foot, the following table is obtained:

Candle Power of Gas at 16-Candle Rate Corrected to 5 Cubic Feet.	Pressure of Gas. 1 Inch. Total Light. Candles.	1 Inch. Candles per Cubic Foot.	2 Inch. Total Light. Candles.	2 Inch. Candles per Cubic Foot.	3 Inch. Total Light. Candles.	3 Inch. Candles per Cubic Foot.
13.32	56.0	14.8	60.0	11.0	56.0	8.3
14.18	57.0	16.2	55.5	11.7	55.5	9 6
14.80	57.5	16.6	53.0	10.9	49.0	8.2
15.65	63.0	17.8	77.0	15.9	72.5	12.0
16.19	51.0	15.0	57.5	11.9	61.0	10.8
16.48	55.0	17.5	61.5	13.2	61.5	10.7
17.35	63.0	18.9	70.5	15.0	67.0	11.5
18.30	55.5	16.2	47.5	10.0	44.5	7.8
19.90	53.0	19.1	86.0	21.8	92.5	19.0
23.70	62.0	21.7	87.0	21.7	89.0	18.5

This shows that the general tendency of such variations of pressure is to decrease the candles per cubic foot of gas consumed, and that any increase of the total candle power is due to a very largely increased consumption.

When, however, high pressures are used, *i. e.*, pressures of 8 to 10 inches, such as are employed in high intensity lighting on the Sugg, Keith, or other systems, the high pressure of the gas enables some 10

cubic feet of gas to be consumed per hour, in place of the 3½ cubic feet supposed to be used by the "C" burner; so that nearly three times the amount of gas is burnt in the same time and area, which results in a great increase in calorific intensity, with the result that over 30 candles per cubic foot can be obtained with London gas, and, of course, higher powers with a richer gas.

I long since pointed out the importance of a thorough mixing of the gas and the air drawn in by the atmospheric burner in increasing the light given by the mantle, and it was to do this that Chemin, Denayrouse, Bandsept and Kern devised the special forms of burners associated with their names. The late Mr. Frank Livesey also showed that by allowing the gas to take in the needed air some distance away from the burner head, so that a length of travel should bring about a more thorough mixing, an enhanced effect could be produced. In the paper by Mr. Grafton, already alluded to, he shows, by carefully made photometric experiments, that by making a mixture containing from 15 to 30 per cent. of air with the coal gas after leaving the gas meter the light emitted by the mantle is increased to such an extent that it far exceeds the ordinary results obtained for the same consumption of gas by other methods.

This method of burning gas for incandescence is in practical use on the Continent, and is giving such excellent results that its use is rapidly spreading. It was as early as 1894 that Daus took out a patent for the production of an intensely hot flame by the use of a mixture of gas and air made by a suction air drum driven by the gas meter, which secured a constant mixture of the gas and air in the required proportions. He used the flame for heating Fahnehjelm combs. Later on Doller, Fuller, and finally the "Selas" Company, took out further patents on improvements of the same idea, and under these combined patents they have made a great success, the last installation being in the Thiergarten, in Berlin, where the results attained are said to be exceedingly good.

The so-called "Selas" system consists of a small apparatus for the mixing of 2 volumes of air with 1 volume of gas immediately after the consumer's meter, and which is worked by a small water motor using 1.2 liters, or a little over a quarter of a gallon, per burner per hour; or, if desired, it may be worked very cheaply by an electric motor. The results obtained by this method, which is intended for use in the house, are that with a consumption of 3.53 cubic feet of coal gas in admixture with air a light of 134 English candles is obtained, whilst with a consumption of 4.24 cubic feet of gas the light rises to 167.9 candles, or 39.5 candles per cubic foot.

These results are obtained with Berlin, Stockholm, and Copenhagen gas, the illuminating power of which varies from 14 to 15 candles; whilst with a high pressure system on the same lines, but with a compressor as well as a mixer, over 45 candles per cubic foot are obtained with the same low power gas. I have not tested the results myself, but the fact that they have been obtained by Mr. F. D. Marshall at the Copenhagen gasworks is a sufficient guarantee of their correctness; and I hope Mr. Marshall will be able to give a paper and demonstration of these remarkable results at the next meeting of the combined Institutions.

A very interesting phase of high pressure illumination, which tends in the same direction, is to be found in some experiments made by Mr. R. G. Shadbolt on the effect of using air under pressure to suck in coal gas, instead of the gas sucking in air. In order to do this he removed the gas nipple from an ordinary injector burner and supplied air instead of gas through it, and sucked in the gas through the side holes. He found that by passing air in at a pressure of 32-tenths (3.2 inches) he got a consumption of 18 cubic feet of 17 to 17.5-candle gas, and a duty from the mantle of 678.5 candles, or 37.69 candles per cubic foot.

[To be Continued.]

[Concluded from Vol. LXXVII., Page 947.]

Blast Furnace Gas Engines and Their Work.—No. III.[1]

Oechelhaeuser.—The construction of the Oechelhaeuser engine is well known. Like all the early engines these gave considerable trouble in practice at first, but are said to have involved little difficulty for some time since. So far as I know, it is only the governing in the driving of dynamos which is not quite satisfactory and is, therefore, to be changed. Sometimes, too, the outer jackets crack for the same reason that fractures occur with the cylinder heads of other engines. I believe that the latter drawback might be overcome if the short middle casting of the older engines, which is the explosion chamber proper, is not made with double walls, but is arranged by riveting on an outer jacket of sheet metal. The construction of the engine has been improved in several respects.

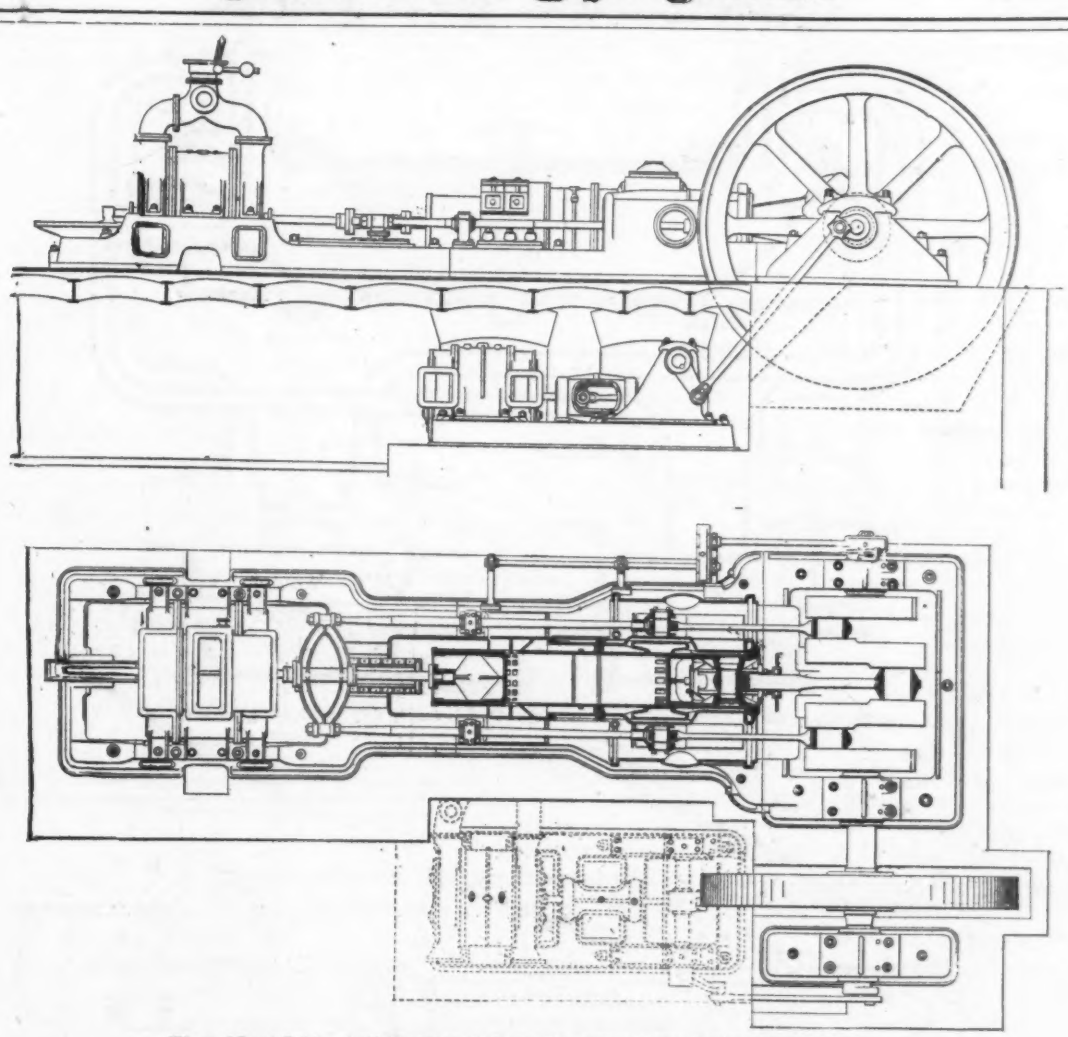
The operation of the engine may be described as follows, referring to Figs. 15, 16, 17 and 18, the first two showing a motor coupled to a blowing engine and the second two one driving a dynamo. When the two pistons are closest to one another the space between them is filled with a compressed mixture of gas and air. On igniting it the pistons are driven asunder. At first the forward piston uncovers a ring of slits in the cylinder. At this moment the exhaust of the gases of combustion begins. Soon afterward the rear piston opens a second series of slits on the opposite end of the cylinder, through which air compressed to 0.3 to 0.4 atmosphere enters and takes care of the complete expulsion of the residual products of combustion. Then follows a third ring of slits. In the older designs a mixture of air and gas was forced in through these. In the more recent designs it is only gas, so that now the mixture is made in the cylinder proper. Since the exhaust slits open earlier and remain open longer than the gas intake slits there might be some fear that the gas mixture might be blown through. This is improbable, because in normal working a volume of mixture equal to only 70 per cent. of the piston displacement is used. When the return movement of the pistons starts the slits are covered one by one, the mixture is compressed to 8 to 10 atmospheres and the operation begins anew. One of the principal advantages of this system, therefore, is the absence of all valve gear. With the exception of a small valve for starting the engine with compressed air there is no mechanism on the cylinders.

The chamber of combustion and the working chamber is a straight cylinder in its simplest form. It is stated that deposits of dust, etc., do not occur to the same extent as they do with engines equipped with valves. Furthermore, the cylinder is cooled by the compressed air admitted, and if the latter be deliberately used this applies also to the exhaust slits and the metal in their immediate vicinity. With the simpler form outer cylinder cooling is very effective. The water cooled piston may be readily removed. Owing to the fact that both pistons run in opposite directions and that the connecting rods operate upon cranks placed at an angle of 180°, the moving masses are largely counterbalanced and the engine rests relatively solid on its foundation. In spite of the fact that the bearings of the crank axle are wide apart it is not subject to serious strains, because the latter counteract one another to a considerable extent. There is probably no necessity for the two inner flywheel bearings which are often employed in twin Oechelhaeuser motors, so that the width of the engine might be reduced. In the later designs two igniting mechanisms are used, which may be taken out and cleaned, if necessary, while the engine is running. This is worthy of imitation. The pump which supplies gas and air is placed below the foundation in the case of motors driving blowing engines, otherwise it is placed back of the working cylinder. One of the disadvantages cited against the system is that there are two connecting rods for the rear piston, which involves very accurate adjustment. Another point made is that air and gas are supplied by one piston, which, however, does not seem to have led to the slightest difficulties in practice.

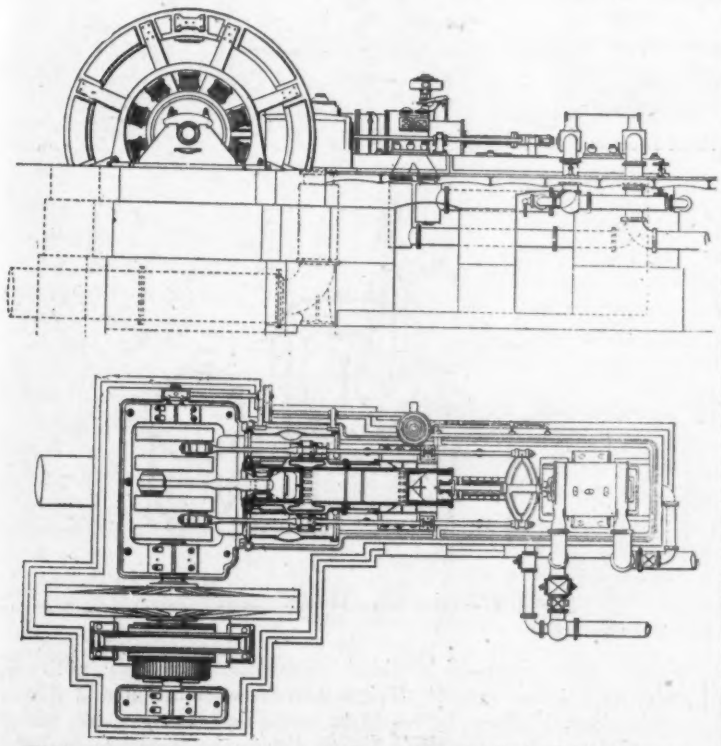
In driving blowing engines the Oechelhaeuser has the advantage that no stuffing box is necessary for the gas engine when the blowing tube is placed in line with it. With the twin arrangement the engine is suitable for driving alternating current dynamos, provided the new system of regulation comes up to expectations. I cannot give any details as to the character of this system of regulation, because the trials have not yet been concluded. Letters from the Deutsche Kraftgas Gesellschaft indicate that two types of regulation are provided for; one, less exact, by changing the flow of gas and the other by changing the quantity of gas and in a minor degree the quantity of air. To me the latter does not seem a very easy matter in the case of the Oechelhaeuser motor.

The simplicity of the Oechelhaeuser engine is exceedingly attractive. One consideration is, however, that when once built no changes are possible in the methods of providing for the admission and exhaust. In this respect the quantities of gas and of air, the time, governed by the length of the slits, the area of the ports and the compression are dependent upon one another. It may be assumed, however, that now sufficient experience has been obtained. In the latest designs the indicated work of the air and gas pump has been brought down to about 6 per cent. of the indicated work of the working cylinder. The mechanical efficiency is stated to be 78 to 82 per cent. The Deutsche Kraftgas Gesellschaft reports the experience with the engine in driving blowing engines. When the blast pressure increases the engine automatically runs at a somewhat lower but uniform number number of revolutions. One necessary condition is, however, that at normal blast pressure the gas engine is not yet working at its normal rate per revolution, and

1. *Iron Age.*



Figs. 15 and 16.—Oechelhaeuser 500-Horse Power Gas Motor Driving Blowing Engine.



Figs. 17 and 18.—Oechelhaeuser 500-Horse Power Gas Engine Driving Dynamo.

that the auxiliary pump is relatively so large that ordinarily with throttled gas valve it sucks a sufficient amount of gas under a certain degree of vacuum. When the number of revolutions declines this vacuum is covered and a large quantity of gas is supplied. Since the quantity of air does not vary, there is therefore a corresponding excess of air and a somewhat larger consumption of gas during normal working. Ordinarily a higher blast pressure, when blowing engines are driven by gas engines, is obtained, without change of work, by reducing the quantity of air drawn in, or in other words, by beginning the compression in the gas engine later. It is also obtained in a simple manner by providing large dead spaces, an idea patented by Grabau for the Nuernberg Company.

Blast Furnace Gas Engines and Their Work.—No. IV.[1]

The Koerting Double Acting 2-Cycle Motor.—The latest in the field of the gas engine is the double acting 2-cycle motor, which was put in operation in the beginning of the present year, after the firm had quietly tested a motor at their works in the most thorough manner. So far as I know these engines have met all expectations. At the Düsseldorf Exposition the design was represented by two first-class machine shops, Gebrueder Klein, of Dahlbruch, and by the Siegener M. A. G. Both of the engines were in operation daily, the former being used for driving a rolling mill train, while the latter was employed in operating a blowing engine. As will be seen from the accompanying engravings, Figs. 19 to 22, inclusive, the piston has a length about equal to the stroke of the engine, while the working cylinder has somewhat more than double its length, and that it and its jacket are cast in one piece. At both ends of the working cylinder a simple head is secured which, in a special box, carries the inlet valves, which are operated by cams from the valve shaft. Beside this valve there is attached to the cylinder head only the small valve for starting the engine with compressed air. The motor has no exhaust valves, the gases of combustion escaping as they do in the case of the Oechelhaeuser engine. The working piston when it occupies the end of the stroke uncovers a series of ports through which the gases may escape during a certain arc of the crank travel. The valve has two annular openings which continue as two separate pipes, one of which goes to a gas pump, and the other leads to an air pump, as is closely shown in Fig 19. The auxiliary pumps, which are necessary to supply the mixture of gas and air, have been located by Koerting alongside of the working cylinder. They are driven by a crank which is 110° in advance of the working crank and are operated by one rod. They have simple piston valves so arranged that the rear part of the gas pump and the rear part of the air pump deliver only to the rear end of the working cylinder through the separate pipes. In order to explain the method of operation of the working cylinder we will assume that the piston occu-

1. *Iron Age.*

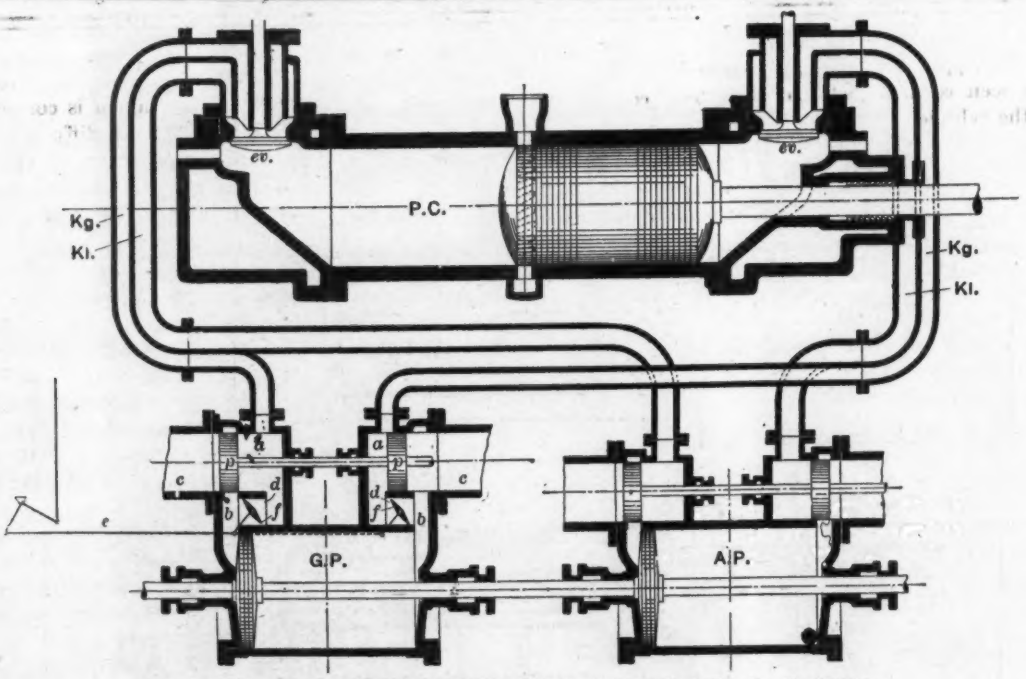


Fig. 19.—Plan Showing Method of Working of Double Acting 2-Cycle Koerting Gas Engines.

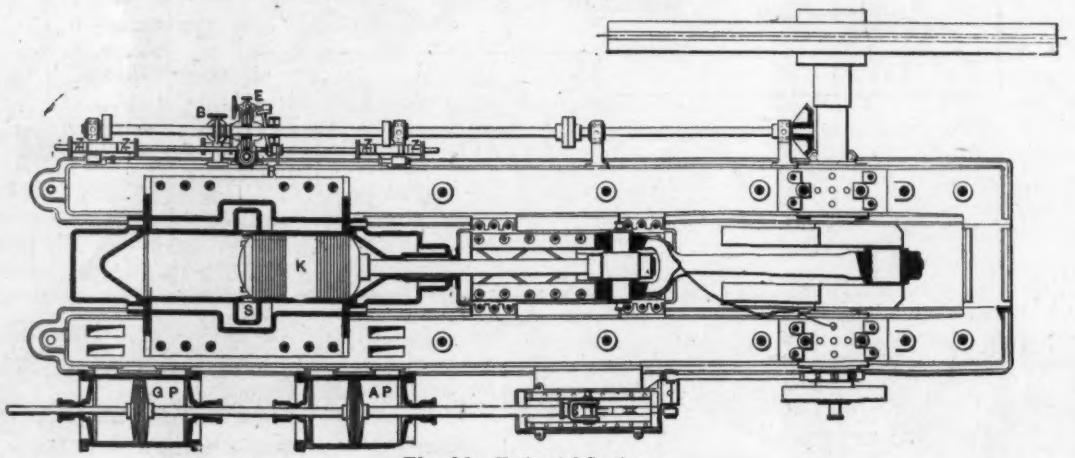


Fig. 20.—Horizontal Section.

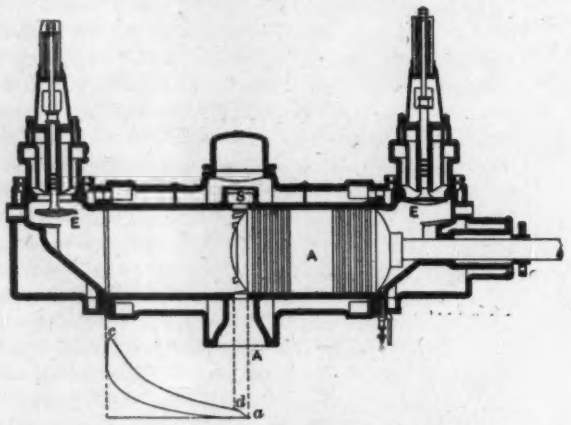


Fig. 21.—Longitudinal Section through Working Cylinder.

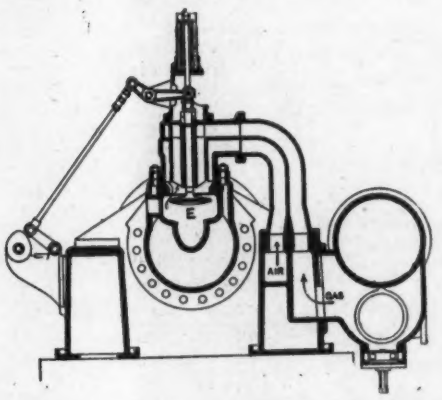


Fig. 22.—Cross Section through Admission Valve.

Koerting Double Acting 2-Cycle Gas Engine.

pies the rear end of the cylinder at the beginning of the expansion stroke. After the edge of the piston has reached the exhaust port the work of exhausting begins. The pressure of the gases of combustion rapidly drops to atmospheric pressure and soon afterwards the inlet valve opens even before the dead center has been reached. As will be noted further on, the arrangement of the charging pumps is so made that at this moment air alone is first delivered. This expels the gases of combustion, cools the cylinder and forms a separating layer between the gases of combustion and the fresh mixture, which enters in the next moment, the delivery of gas having also begun. The dimensions of the two pump pistons bear such proportion that the correct mixture is delivered into the working cylinder corresponding to the character of the gas in use. After the inlet valve has been closed the contents of the working cylinder are compressed to about 10 atmospheres. Then, at the dead center, two electric igniting devices start the combustion and the compression begins anew. It should be noted that owing to the peculiar form of the compression space Koerting claims to secure the much discussed layers of air and mixture. This would prevent the diffusion of a correct mixture of air and gas with an excess of air in the case of light loads or when running without a load. According to this the engine would always secure a good mixture at the time of ignition and would, therefore, secure certainty of ignition and regularity of compressions even under a light load. From Fig. 15 it will be observed that the gas pump is located toward the rear, while the air pump is placed forward. Through the aid of the valves *p*, *p*, the ports *b*, *b*, are connected with the gas supply pipes *c*, *c*, during the suction stroke, while during the com-

pression they are connected with the pressure line *Kg*. The same is true of the air cylinder and its supply pipe and the pressure line *Kl*. The pipe connections have been so arranged that their total contents are equal for each side of the cylinder.

The gas pump is supplied with two throttle valves, *f*, *f*, so placed that when opened they connect the cylinder port *b*, *b* with the pressure pipe *Kg*. To begin with, however, let us assume these valves to be closed. The air cylinder is so operated that the piston valve cuts off the air cylinder from the air supply at once after the end of the suction stroke, and immediately afterwards connects it with the pressure line. When, therefore, the piston makes its return stroke, compression is brought about in the pipe until the inlet valve of the working cylinder is opened.

Since the pump crank is 110° in advance, this takes place at the moment when the pump piston is about at the middle of the stroke. The gas cylinder, however, works in such a manner that the valve keeps the cylinder connected with the exhaust during the whole of the exhaust stroke and about during one-half of the return stroke. It is only then that the valve cuts off the supply and soon afterwards opens the pressure pipe. So far as the gas is concerned, its compression begins only when the inlet valve is opened. When the inlet valve has just been closed then gas and air are in their pipes above the inlet valve.

For the next period the forward end of the air pressure port on the left side is connected with the air pump cylinder at atmospheric pressure, the air pump piston occupying the position at dead center. At this moment, therefore, the mixture has a pressure which reduces the pressure in the air port. The result of this is that the gas which is at the time cut off from the gas pump cylinder expands through the valve from the gas port into the air port, but the pressure grows so rapidly that the former pressure is already reached before the pump piston arrives at its center position. Therefore the gas first occupies its former position and is forced back a distance into its own port before the inlet valve is opened. The gas pump only begins to deliver at this time; that is to say, when the gas pressure port is opened a pressure of the mixture first develops which is less than the pressure in the port, and, therefore, at first brings about a further receding of the gas from the valve. For this reason we have from this point an equal pressure in the air cylinder, and in the two supply ports. When the air and gas pistons continue their travel air and gas are delivered in the proportion of the piston area into the ports, so that when the inlet valve is opened air alone enters at first, the gas having been crowded back, and then air and gas are delivered into the working cylinder in the proportions desired. The formation of the mixture, therefore, begins only directly at the inlet valve and is almost independent of the pressure in the gas supply pipe and of possible fluctuations.

This method of supplying the working cylinder applies to the maximum work of the engine, for which the total quantity of gas drawn in by the engine or about one-half of the gas pump cylinder contents are forced into the working cylinder When the load changes the governor must serve a device through which the time of admission of gas into the working cylinder is changed. Theoretically this would be best attained if the time of beginning the delivery by the gas pump were altered, and that, therefore, the piston valve of the gas pump cylinder should close later the connection with the gas supply pipe.

The first engines were so designed that the governor acted upon the piston valves. This, however, involved so much friction that it was changed as shown in the sketch. Whenever the throttle valves *f f* between the gas cylinder and the gas supply pipe are not completely closed the gas pump is in constant connection with the gas pressure pipe line. In this line there is a pressure of 0.5 to 0.6 atmosphere, and this pressure brings about that during the suction stroke of the gas pump piston and during the unchanged part of the return stroke gas escapes from the line into the cylinder and thence into the gas supply main. In this arrangement the gas does not expand into the air port at the end of the suction stroke in the air cylinder as before and is only subsequently forced back, but the gas at once recedes from the inlet valve and makes room for air by the back flow even before the beginning of the suction stroke. It is only when the piston valve has closed the gas supply and delivery begins that the back flow stops and that the gas is again forced forward in the port, whereby the direction of the current changes in the throttle valve *f*. It depends, therefore, upon the position of the valves, as determined by the governor, whether more or less gas flows back out of the port and whether gas mixes with the air flowing in through the inlet valve at an earlier or at a later period. The throttle valve is not designed as shown in the engraving, but is a counterbalanced valve. Particularly when producer gas is being employed it will be necessary to clean it very frequently.

Under the new arrangement the governing is very simple and is likely to meet all requirements. Of course, it implies a loss of energy, because the quantity of gas flowing back with every stroke is uselessly compressed. If this delivery by layers is correct, it is a question of regulating by quantity, provided that no diffusion of the mixture with the gases or air on the opposite side occurs during the period of compression. The compression is influenced by the governing, though not to a very pronounced degree, since the same quantity of air is always employed.

From the above description the conclusion seems justified that about one-half of the air cylinder contents is employed in every stroke to blow out the gases of combustion or to form an air layer back of the piston. The mechanical efficiency of this engine, therefore, since the pumps must deliver gas and air under a pressure of about 1.6 atmospheres, must be lower than it is in the case of a 4-cycle engine. I have no data on this point, but the Koerting motor and the blowing engine connected with it at the Nieder-Rheinische Huette have been tested for some time by Professor Meyer, so that we shall probably soon have information on this point.

The claim is made that the indicated work of the pumps is unduly high in the Koerting engine. As stated, it is said to 6 to 7 per cent. of the indicated work of the working cylinder in the Oechelhaeuser motor, and I see no reason why it should not be brought down to a similarly low figure in the case of the Koerting. If this work is really much greater with the Koerting it may be due to the fact that too large a quantity of air is used, that perhaps too high a pressure is necessary in the pumps, because the sections of the ports and of the inlet valve are relatively too small, and that the immediate opening of the pressure ports at the beginning of the compression calls for excessive work. Poor mechanical efficiency would above all influence the consumption of gas per hour per effective horse power and also the dimensions and the price of the engine. At the present time a minimum consumption of gas does not play an important part in blast furnace gas engines, so that it is only a question to decide whether the other advantages of the engine are not paid for too dearly.

In judging of this double acting engine the following should be taken into consideration, besides the method of forming the mixture and the inner cooling by a fresh supply of air for the expulsion of the gases of combustion: At each end of the working cylinder there is only one valve, and that is the inlet valve, which is cooled by the inflowing mixture and therefore causes no trouble. Besides, this valve does not work against a pressure, but in opening it meets the atmospheric pressure in the working cylinder. There is no exhaust valve which must be cooled with water, as in the larger 4-cycle engines, and which puts a heavy strain upon the governor shaft. While the latter makes the same number of revolutions as the crank shaft, as compared with one-half the number of revolutions in the 4-cycle engines, it is a fact that it is only under light loads and runs more quietly than it does in the case of the 4-cycle engines. The cylinder head with its one valve is smaller. It can be cooled more effectively and, therefore, is safer so far as durability is concerned.

The temperature of the working cylinder remains low, owing to the water jacket and owing to the fact that it is in contact with the very long water cooled piston. According to Koerting the temperature is similar to that of a steam engine. This makes lubrication a simple matter. The cylinder is exposed to high temperatures only at its ends and for a short distance. The parts in the vicinity of the exhaust ports do not seem to me dangerous, because these ports are almost continuously covered by the long piston and are cooled with it. The deposit of dirt in these ports is said to be small, because the blowing out is not effected in one direction, but alternately in both. When the piston is at the dead center point, therefore, when there is the highest pressure on one side, all the 14 piston rings are effective. Therefore, there does not seem to be any danger of leakage.

The engine works at once, even in starting, with about 10 atmospheres pressure, and when the compressed air for starting is somewhat lower in pressure no air can enter even when the starting valve is open, and thus spoil the mixture as soon as it is once in the cylinder. Therefore the starting does not require special attention. It is worthy of note that blowing off valves are arranged for the Koerting engine through which excess oil and dirt may be blown out while the engine is running. Besides the drawback of possible lower mechanical efficiency the point may be raised against this engine that any leakage or corrosion of the piston can only be observed later than in the case of the open 4-cycle engine; that stuffing boxes are necessary, and that the removal of the piston is more difficult and takes more time, because one cylinder head and a part of the gear must be removed for this purpose. I do not doubt, however, that Koerting will soon improve his design in this respect, as soon as the Deutz and Cockerill people have built their 4-cycle engines, shown thus far only in drawings, which do not have this drawback.

[To be continued.]

Storage Batteries in Electrical Supply.

By Mr. Alton D. Adams, in *Electrical World.*

Maximum loads, energy outputs and the efficiency of storage batteries determine their utility in systems of electrical supply. From these factors the investment in batteries per unit of their greatest load and the fixed charges per unit of their energy output may be determined. These important relations are better studied as they actually occur in existing systems rather than on mere assumptions of what could or should be done.

To illustrate the practical results that may be obtained with storage batteries, the following data as to their operation in a large system of electrical supply during a period of more than 3 years are presented. During the earliest of the 3 years in question a large part and during the two later years the larger part of the electrical output of this system was derived from water power. This fact is important because water power usually increases the utility of storage batteries, which may be used to deliver the energy of the night flow at times of maximum load. In the electrical supply system here considered the load was well divided between street and commercial lamps and stationary motors, but no electrical cars were operated by it.

The battery in question consisted of 140 cells of standard make, and each cell had a capacity of 17,000 ampere hours, giving a total of 2,380,000 ampere hours' capacity. At an average discharge pressure of 2 volts per cell the battery thus had a capacity of 4,760 kw. hours. On a 10-hour rate of discharge the battery would deliver 476 kw., and on a 5-hour rate 952 kw. On an average week day of each month during 1901 the maximum rates of battery charge and discharge, also the ratio of battery discharge at its highest rate to the maximum load of the electrical system, were as follows: For the months of June and July the ratios of maximum battery loads to maximum station loads are not given because these loads did not nearly coincide in point of time.

	Maximum Kilowatts Battery Charge.	Maximum Kilowatts Battery Discharge.	Percentage of Maximum Battery Discharge to Maximum Loads on the System.
January	390	520	19.1
February	240	970	39.2
March	280	240	14.2
April	330	300	17.0
May	330	300	17.4
June	200	200	....
July	150	200	....
August	210	440	27.1
September	360	270	15.3
October	360	400	16.2
November	240	330	13.5
December	340	340	11.0

The highest charging rate for the battery during the year was only 390 kw., corresponding to the battery discharge on a 12.2-hour rate. The highest discharge of the battery was 970 kw. in February, amounting to a 4.9-hour rate. In the other months of the year the maximum rate of discharge was constantly above 9 hours, and for the greater part of the time above 14 hours. The battery thus worked much below its maximum capacity both in charging and discharging, a condition favorable to high efficiency. During the 12 months the highest load on the electric system for an average day was 2,840 kw., and of this load the battery capacity at a 5-hour rate of discharge was 33 per cent., yet the battery actually carried only 11.9 per cent. of the maximum load. In February, when the battery carried 39.2 per cent. of the maximum load on the system, the discharge rate was 4.9 hours, and this percentage was the largest carried by the battery in any maximum load. In only one other month, August, did the battery carry more than 20 per cent. of the maximum load on the system. As a 5-hour rate of discharge for a battery at the time of maximum load is within the limits of good practice, it is notable that the battery in the present case reached this rate in but 1 month. The battery capacity being at command, but to a large extent not used during 11 months of the year, raises the natural inference that the station management found it cheaper to operate engines or water wheels and dynamo at the time of maximum load than to charge and discharge batteries. Service from the battery extended over the last 3 months of 1898, all of 1899 and 1900, and all except the months of June, July and December, in 1901. During this entire period the extent to which the battery has been used has been in general on the decline. Thus in the last quarter of the year of 1898 the battery discharged 103,800 kw. hours, during 1899 about 3 times and during 1900 a little more than twice this amount of energy, while the record for 9 months of 1901 shows a discharge of only 165,487 kw. hours.

Year.	Months of Year.	Kilowatt Hours Battery Discharge.	Percentage of Battery Discharge to Total Station Output.
1898	last 3	103,800	7.6
1899	12	317,798	5.4
1900	12	222,355	3.0
1901	9	165,487	2.5

The decreasing extent to which the battery has entered into the operations of the electrical supply system is still further brought out by the percentages of battery discharge to total station outputs in kw. hours. Thus, in the last 3 months of 1898 the battery supplied 7.6 per cent. of the entire output of the system, in 1899 and 1900 the like percentages for the battery were 5.4 and 3.0 respectively, and during 9 months of 1901 the battery discharged only 2.5 per cent. of the entire station output for the same period.

Viewing the years of 1899, 1900 and 1901 as to percentages of battery discharges in each month, it seems that the extent of battery use has varied but little with the time of year. The decline in the monthly use of the battery extends with slight breaks from January, 1899, to December, 1900. Percentage of battery discharge to total kw. hour delivered by the system in each month.

	1899. Percentages.	1900. Percentages.	1901. Percentages.
January	6.9	3.6	2.8
February	5.7	3.1	2.7
March	6.5	4.0	2.0
April	6.3	5.1	2.6
May	6.2	2.5	1.8
June	5.2	2.8	..
July	5.5	1.8	..
August	4.7	1.3	2.5
September	4.3	2.4	2.6
October	5.5	3.9	1.8
November	4.4	2.8	4.0
December	4.6	2.5	..

During 1901 the percentage of battery output shows no regular increase or decrease from month to month. In the 3 months of this year for which no figures as to percentage are given the battery is believed to have been in use, but the data of charge and discharge are not available. As far as can be learned, the decline in the use of this battery is due to no special circumstances, but simply to the idea that its employment to a greater extent would not pay. For the electrical supply system that includes the battery, the number of kw. hours delivered during 1901 was 1.4 times that delivered during 1899, so that the smaller use of the battery is not due to a decrease in the station output.

Efficiency of this battery, measured by the ratio of kw. hours of discharge to kw. hours of charge in each year, shows a material falling off during the period in question. For the last 3 months of 1898, when the battery was new, the efficiency was 75.6 per cent., but in the 9 months of 1901 the efficiency was down to 64.6 per cent. This loss of efficiency is the more notable because of the moderate rates at which the battery was charged and discharged.

	Battery Charge Kilowatt Hours.	Battery Discharge Kilowatt Hours.	Battery Efficiency.
3 months 1898...	137,209	103,800	75.6
12 months 1899...	463,433	317,798	68.5
12 months 1900...	318,479	222,355	69.8
9 months 1901...	255,824	165,487	64.6

From these figures it appears that the efficiency of the battery declined 11 per cent. during a little more than 3 years. At a price of $20 per kw. hour of rated capacity this battery of 4,760 kw. hours would have cost $95,200. During the year of 1900 the battery discharge was 222,355, so that there was 43 cents invested in the battery for each kw. hour delivered by it on this basis of cost. Allowing 15 per cent. of battery cost for annual interest, repairs and depreciation, these charges would have amounted to 6.4 per kw. hour delivered by the battery during the year named. Facts similar to those stated here no doubt have a bearing on the failure of American central stations to adapt storage batteries more rapidly.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At a special meeting of the shareholders in the Steelton (Pa.) Home Gas Company it was unanimously resolved to take over the properties of the Steelton Fuel Gas Company. Both of the absorbed Companies were chartered corporations, but neither had gone in for actual work under its franchise.

The Granville (N. Y.) Light, Heat and Power Company began to supply gas about a fortnight ago. The officers of the concern are: President, Brodie G. Higley; Vice-President and General Manager, William J. Gallagher; Secretary and Treasurer, N. T. Drake—all residents of Sandy Hill, N. Y.

MR. J. W. BERTHOLF has accepted a responsible position with the Oskaloosa (Ia.) Gas Company.

THE answer of the Buffalo (N. Y.) Gas Company, in the injunction suit brought by Mr. Wm. C. Moore, of Putnam street, Buffalo, to restrain the Company from taking out his gas meter if he refuses to pay a monthly charge of 50 cents for "service," has been served upon Charles L. Feldman, attorney for the plaintiff. The answer denies that the 50-cent charge is for rent of meter, and alleges that the charge is a minimum rate per month for service, made necessary by the action of many property owners in putting in meters for emergency lighting only. The answer admits that the Company contracted to furnish Mr. Moore with gas at the rate of $1 net per 1,000 feet, and that he has offered to pay at that rate for all the gas he has used, but alleges that the contract was made with a limitation; that before the commencement of the action the Company "had established a minimum charge of 50 cents a month as the price that should be paid by its consumers, provided the consumption of gas by such consumers did not, at the rates specified, amount to 50 cents per month." The Company denies that it has been charging its consumers any sums of money whatever as "rent of meters," but states that each customer accepted by the putting in of a meter puts upon the Company a certain expense, incident to putting in the meter, making connections, making inspections of meters, keeping books and presenting and collecting accounts, and that the charge made upon Mr. Moore is no more than adequate to make good the absolute cost of such service. It is further claimed that each customer, when he applies for a meter, makes a written agreement by which he binds himself to pay this charge, and that Mr. Moore made such an agreement on September 11th, the day before the meter was installed; wherefore, although he used no gas at all up to October 27th, and only 100 feet up to November 24th, he is liable to a minimum charge of 50 cents for both months. The Company assails Sec. 69 of the transportation laws, on which the suit is based, as being unconstitutional and void, in that it violates Sec. 6 of Article 1 of the State Constitution and Article 14 of the Constitution of the United States, by taking the property of the Company without due process of law, and without compensation. This contention is based upon the allegation that the law objected to requires the performance of a substantial service without any compensation, and subjects the Company to a penalty for the making of a reasonable charge for the use of its property. The answer is concluded with the following interesting statements: "That such minimum charge was reasonable and proper because of the fact that the plaintiff meets in competition in the city of Buffalo the natural gas which is used by many for a good many purposes, and which is sold at a lower rate than the defendant can afford to sell its manufactured product, and also with incandescent lighting by electricity. That the defendant fully recognizes the right of any property owner or occupant of the city of Buffalo upon its streets through which its gas mains run to have a supply of gas, but that very many who use natural gas, or have facilities for electric lighting, and being uncertain as to the continuity of the supply of natural gas or the electric current, have hitherto applied to the defendant to install meters and make connections therewith and then use the same only in case of necessity or emergency because of the failure of other light. That this custom has grown to such an extent that it was necessary, for the profitable conduct of the business of the defendant, that it should establish a minimum price for gas in order to enable it to make good the actual cost of carrying the customer upon its books and performing the other services which the relation imposes and requires, and that the price so fixed and which the defendant so agreed to pay, as hereinbefore set forth, was not in excess of such cost, but was reasonable and proper."

THE New York city offices of the D. M. Steward Manufacturing Company, of Chattanooga, Tenn., have been removed from 107 Chambers street to No. 8 Jay street.

IT is said that the plant of the Delhi (N. Y.) Gas Company, which has been out of commission for several years, is to be reconstructed by the Smokeless Combustion Company, of this city.

IT is reported that Mr. C. L. Ingraham, of Newark., N. J., has secured more than a controlling interest in the Boonton (N. J.) Gas Light and Improvement Company, the works of which are now being constructed.

THE Crane Company, of Chicago, has asked that a Receiver be appointed to manage the affairs of the Lakewood (N. J.) Gas Company.

THE proprietors of the New Haven (Conn.) Gas Light Company have notified the Secretary of State that they will in due time petition the Legislature to increase the Company's capital, from time to time, in sums the total par value of which shall not exceed not $3,000,000.

THE authorities of Merced, Cal., are considering the good policy of establishing and maintaining lighting and water supply plants on public account.

MR. P. N. BARNESDALL has secured control of the Marion (O.) Gas Company.

MR. PHILO JONES, Superintendent of the Salinas (Cal.) Light and Power Company, has been authorized to announce the following schedule of rates to users of electric currents in that city. The base rate of 15 cents per 1,000 watts will continue, and the discounts will be as follows:

Net minimum rate						$ .75
Net rate on bills of $.75 and under						1.00
5	per cent on bills of $1 and under					2.00
10	"	"	2	"		4.00
15	"	"	4	"		10.00
20	"	"	10	"		20.00
25	"	"	20	"		30.00
30	"	"	30	"		40.00
33⅓	"	"	40 and over.			

MR. T. H. BACHELER, of Chicago, Ills., writing under date of December 26th, says: "Your information regarding the likely ones to secure the franchise for a gas works at Holland, Mich., is 'a bit off.' The projectors of the Peoples Gas Light and Coke Company are the ones who 'are in it.'"

ON the afternoon of December 24th, the employees of the Cohoes (N. Y.) Gas Light Company surprised their Superintendent, Mr. Charles Van Auken, by presenting him with a handsome traveling bag.

AT the annual meeting of the shareholders in the Anderson (Ind.) Citizens Natural Gas Company, it was virtually decided to erect next season an artificial gas plant. The meeting was held the 31st ult.

THE Grand Rapids (Mich.) Gas Light Company, on the 23d ult., tendered to Mayor Palmer 4 carloads of bituminous coal for free distribution amongst the poor of that city on Christmas eve.

MR. F. H. SHELTON and associates are said to be bartering for the properties of the Roanoke (Va.) Gas and Water Company, and the Roanoke Electric Railway and Power Company.

A CORRESPONDENT in Philadelphia forwards the following under date of December 26th: "Manager John D. Shattuck, of the Suburban Gas Company, of Philadelphia, the night of December 23d, was presented with a magnificent chair, made of golden oak, with appropriate upholstery, the gift being a tribute from the employees of the concern. John M. Callanan, who is the Superintendent of the Chester branch of the big corporation, was also remembered with a pair of fine beaver driving gloves from the same source. Both officials are held in the highest esteem by their subordinates, showing clearly the manner in which the employees are treated. The members of the staff of assistants gathered early in the evening on the second floor of the splendid offices of the Company, 517 Market street. Mr. Shattuck was oblivious of the fact that he was to be the victim of a pleasant surprise by those who help to make many of the homes in Chester brilliant with the radiance of their product, but he became cognizant of the fact when Superintendent Callanan got well along with a well prepared and excellently delivered speech. Mr. Callanan incorporated in his address some facts and figures concerning the great strides the Company has made in the few years past, and then prssented the chair to Mr. Shattuck on behalf of the workers. Mr. Callanan's speech was as follows: 'Gentlemen: I deem it an honor to be asked by you to say a few words Although not accustomed to making speeches in public, I feel that we are all one family, and any mistakes I make will be overlooked. About a year ago the Suburban Gas Company came into possession of the franchises, rights, titles, etc., of the Delaware County Gas Company. At that time we were under the impression that the old Company had made rapid strides, and we had a perfect right to think so from the fact that 10 years before, when the old Chester Gas Company was turned over to the Delaware County concern, we received from them 700 meters in use and about 12,000,000 cubic feet of gas per year. At the end of 10 years, when the change was made to the Suburban, we had increased to three times this amount. So you see we were doing some hustling, but we did not know what hustling meant until our friends, the Suburban, came along and took us under their wing, and then we got right down to business, and with the very liberal manner of the Board of Directors in the disbursement of funds for betterments, etc., and the very able way in which our Manager handled the reins, and with judicious advertising, we have been able to show a very large increase. As Superintendent of the Chester branch, I wish to thank each of you for the part you have taken in the work, for unless every man interested had put his shoulder to the wheel, we would simply have stood still and no progress would have been shown whatever. There are other matters in this line that I might say that would be interesting to you, but we have met here for another purpose. On the part of the employees of the

(*Continued on page* 14.)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

MONDAY, JANUARY 5, 1903

(*Concluded from page* 13.)

Suburban Gas Company of Darby, Media and Chester, I take great pleasure in wishing you a merry Christmas, and also in presenting to you, our genial General Manager, this beautiful chair as a testimonial of our admiration and esteem. May you live many years to enjoy it.' Having thus discharged himself of the duty imposed upon him and willingly assumed for the benefit of the employees, it came Mr. Callanan's turn to be remembered in a kindly way as well. Edward C. Burton, one of the accountants of the corporation, stepped forward, and with words of good cheer and ringing with the season's merriment, he tendered the happy returns of the yule tide and the good wishes of the workers, and then presented the gloves to Superintendent Callanan, which are very appropriate indeed, inasmuch as the recipient spends some part of each day driving to the works. A luncheon was then served on the first floor of the Company's offices, and after the boards were cleared a smoker followed. Merriment reigned, the employees contributing songs and recitations to while away several hours. The laborers employed by the Company yesterday were presented with turkeys by the concern, there being about 75 distributed, aggregating about 1,000 pounds. This is the usual custom of the Philadelphia Suburban, which is not only liberal with its employees, but is just and fair in all its dealings with whomsoever it does business."

The Market for Gas Securities.

Although there was no real or even seeming reason for the occurrence, the speculators on Change awoke to the fact that Consolidated was selling at rather low prices. There are those, though, who like to fight with fire, and the nervy gentlemen who sold the shares below 215 are quite likely to be called on to pay the price of their boldness. Consolidated closed to-day (Friday) at 217½ to 218½, which shows a virtual gain of 12 points for the week. The odd thing in connection with the rating is that it is not selling at 250.

Brooklyn Union is nominally held a trifle higher, being 225 bid, which is 10 points away from the opinion of would-be sellers. The situation there with respect to the competition between the electrical current suppliers and the gas men does not seem a serious one. Lacledes are higher and Bay State is lower. Peoples, of Chicago, holds its own, and the inquiry for Washington (D. C.) gas, at anything under 375, is unabated.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JANUARY 5.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	217½	218½
Central Union, Bonds, 5's.	3,000,000	1,000	110	112
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	350	..
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	112½	113
Northern Union, Bonds, 5's.	1,250,000	1,000	108	110
New York and East River				
Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	109	111
Standard	5,000,000	100	130	140
Preferred	5,000,000	100	150	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115½	118
Yonkers	299,650	500	180	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	225	235
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	1⅝	1¾
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	95	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	7½	10
" " Bonds, 5's	5,256,000	1,000	75	77
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Central San Francisco	900,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	99½	201
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¾	89¼
Preferred	3,026,500	100	107½	1
Consumers, Jersey City Bonds	600,000	1,000	103	106
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	71	71¼
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	.	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	380,000	1,000	85	87
Consolidated G. & E. Co.'s.				
Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	.	89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	382,000	1,000	77	79
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	.	.
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	..	68½
" Bonds, 6's	2,650,000	..	102	105
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	81	85
Preferred	2,500,000	100	95	105
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	112	120
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108½
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	218	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	103½	103¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	.
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	41½	42½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	92	94
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	95	96½
Syracuse, N. Y.	1,975,000	100	29	..
Bonds	2,047 000	1,000	99½	100
Washington, D. C	2,000,000	20	380	387½
First mortgage 6's	600,000	..	..	..
Western, Milwaukee.				
Bonds, 5's	4,000,000	..	109½	110
Wilmington, Del.	600,000	50	232	..

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ELECTRICAL APPARATUS.

Wm. Henry White, New York City. 35

PURIFIER SCREENS.

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Christopher Cunningham, Brooklyn, N.Y. 29

INVESTORS.

W. R. Faben Construction Company, Toledo, O. 20

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., Dec. 10, 1902.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable Jan. 15th, 1903, to stockholders of record at the close of business, Dec. 31, 1902. Checks will be mailed.

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By a Superintendent of Many Years' Experience

In the manufacture and distribution of coal gas, laying mains and services, handling gas stove trade, repairing and setting meters, and all work pertaining to the business. Best of references.

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As General Bookkeeper with a Gas Company,

By a man of 17 years' experience. Is familiar with the McMillin system of gas accounting. Can furnish references. Please state salary paid. Address, "BOOKKEEPER,"

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A Gas Engineer or Competent Draftsman,

Experienced in drawing plans for bench construction, and remodelling and extension of a large gas plant. Apply to the

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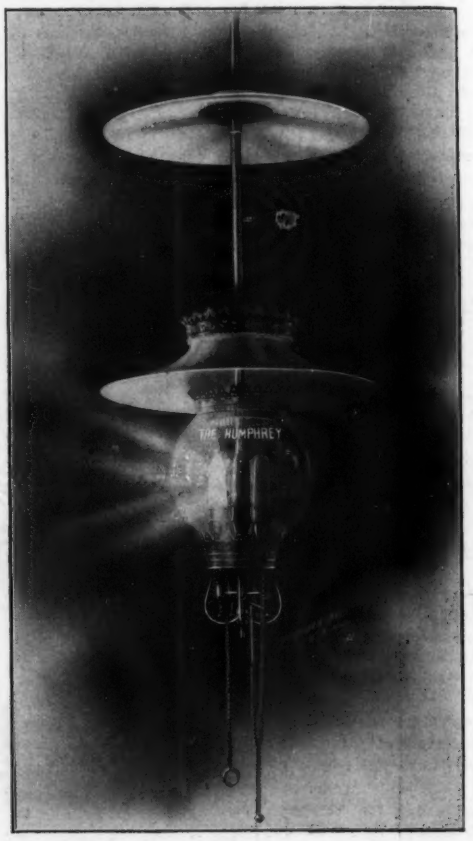
For Store Lighting with One MANTLE NIGHT LAMP.



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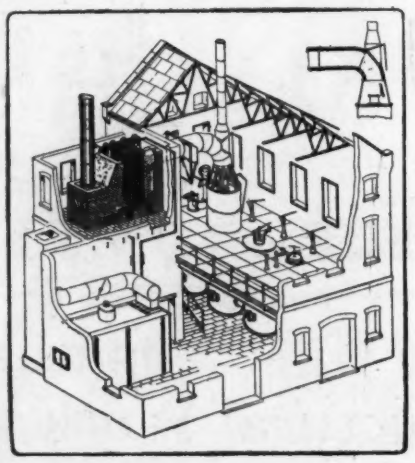

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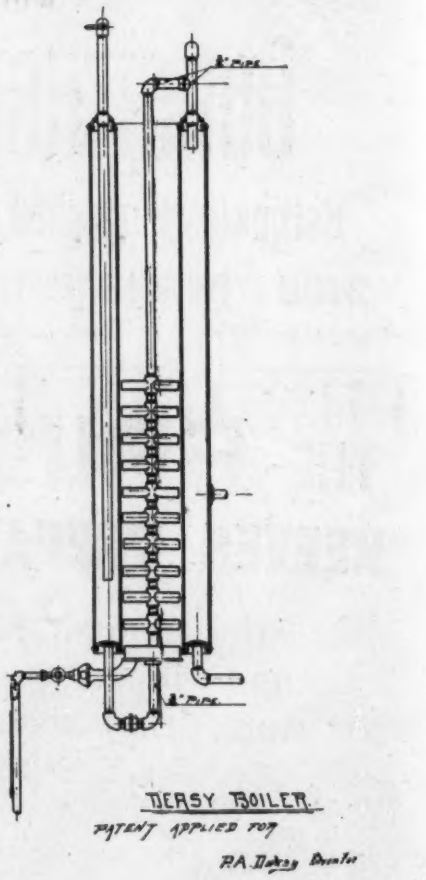

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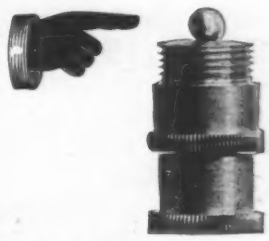

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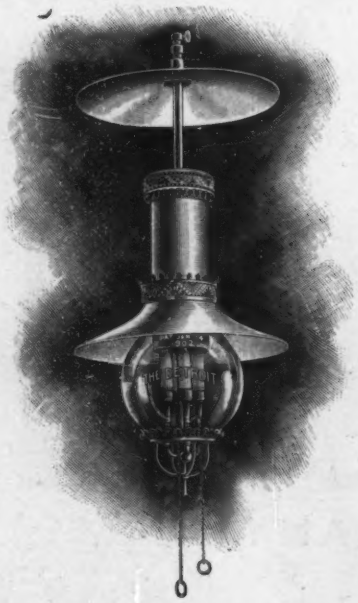

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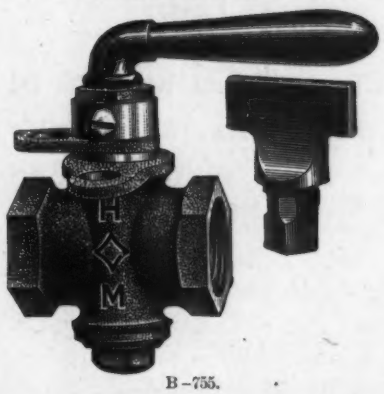

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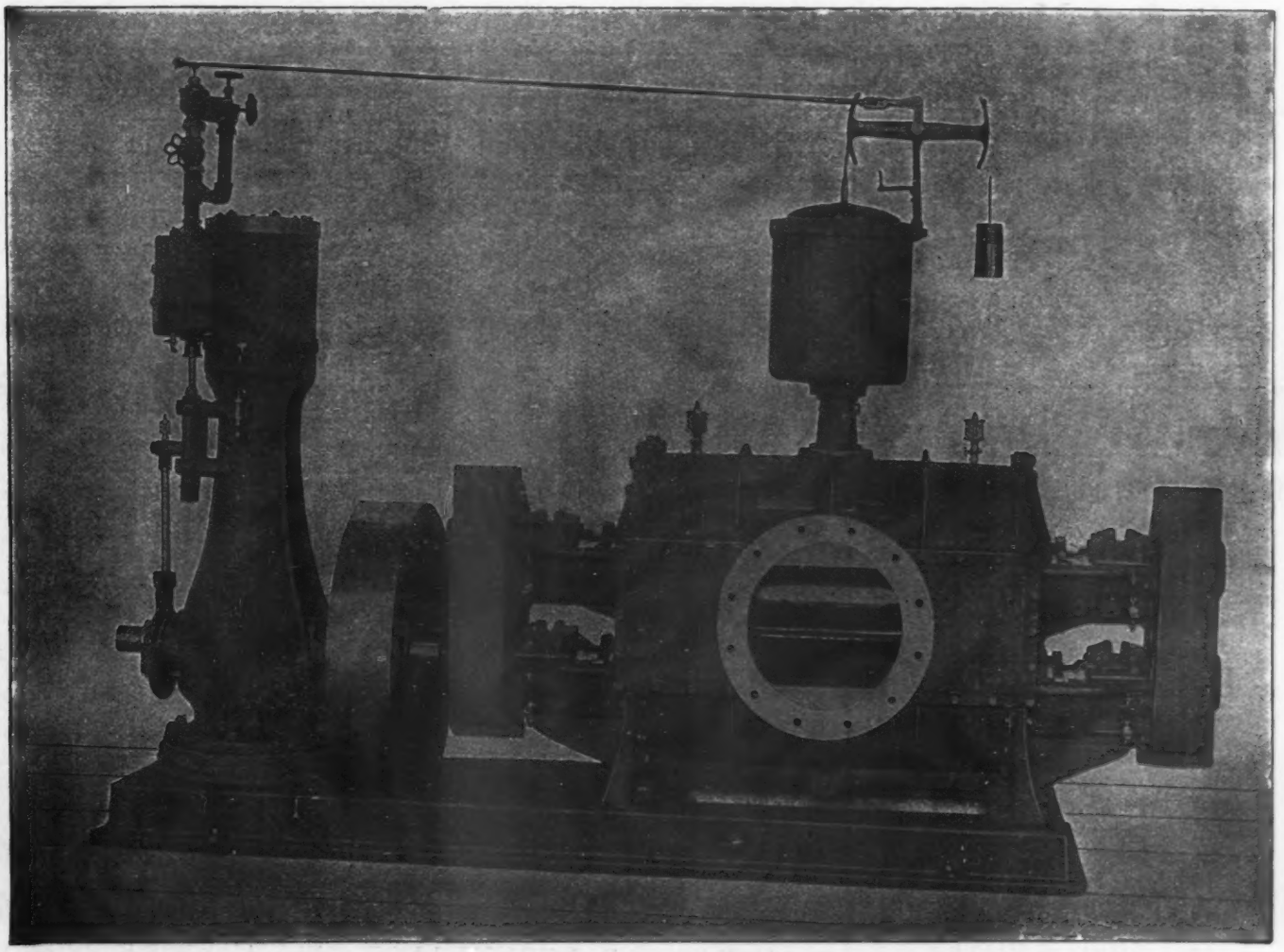

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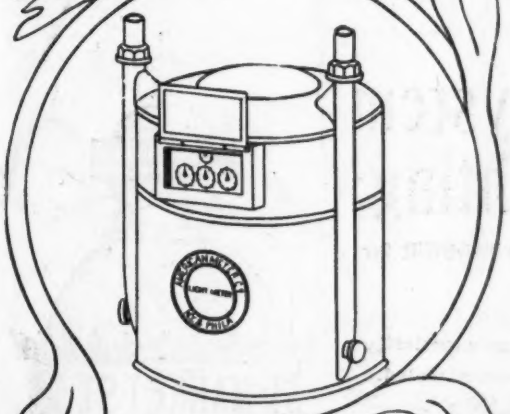
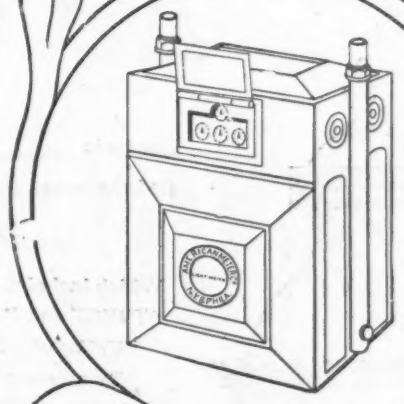
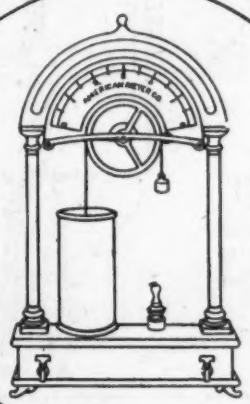
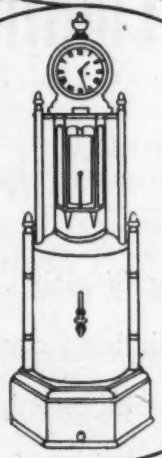
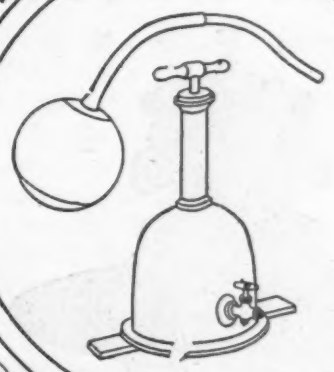
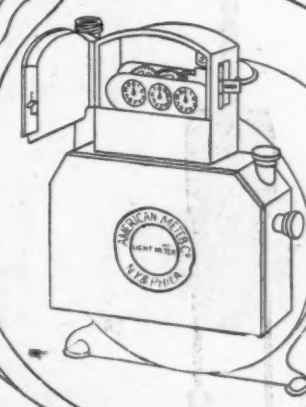












PUBLIC LIGHTING TABLE.

JANUARY, 1903.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Thu.	1	5.10 PM	6.20 AM	4.30	6.30
Fri.	2	5.10	6.20	4.30	6.30
Sat.	3	8.30	6.20	4.30	6.30
Sun.	4	9.30	6.20	4.30	6.30
Mon.	5	10.30	6.20	4.30	6.30
Tue.	6	11.40 FQ	6.20	4.30	6.30
Wed.	7	12.40 AM	6.20	4.30	6.30
Thu.	8	1.50	6.20	4.40	6.30
Fri.	9	2.50	6.20	4.40	6.30
Sat.	10	4.00	6.20	4.40	6.30
Sun.	11	5.00	6.20	4.40	6.30
Mon.	12	No L.	No L.	4.40	6.30
Tue.	13	No L. FM	No L.	4.40	6.30
Wed.	14	No L.	No L.	4.40	6.30
Thu.	15	5.30 PM	8.50 PM	4.50	6.25
Fri.	16	5.30	10.00	4.50	6.25
Sat.	17	5.30	11.10	4.50	6.25
Sun.	18	5.30	12.10 AM	4.50	6.25
Mon.	19	5.30	1.10	4.50	6.25
Tue.	20	5.30 LQ	2.10	4.50	6.25
Wed.	21	5 30	3.10	4.50	6.25
Thu.	22	5.30	4.10	5.00	6.25
Fri.	23	5.30	5.00	5.00	6.25
Sat.	24	5.30	5.50	5.00	6.25
Sun.	25	5.40	6.10	5.00	6.25
Mon.	26	5.40	6.10	5.00	6.25
Tue.	27	5.40	6.10	5.00	6.25
Wed.	28	5.40 NM	6.10	5.00	6.25
Thu.	29	5.40	6.10	5.05	6.15
Fri.	30	5.40	6.10	5.05	6.15
Sat.	31	5.40	6.10	5.05	6 15

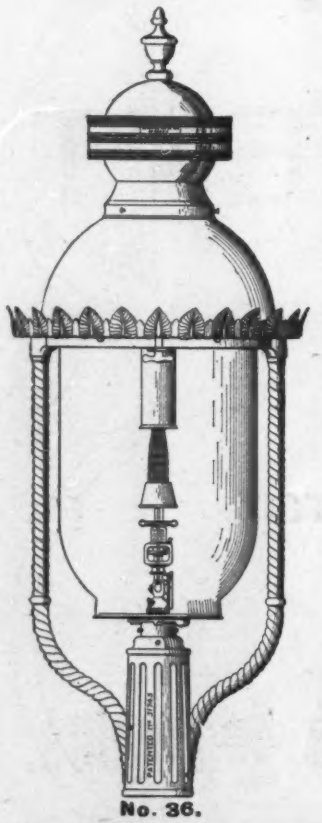
TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....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Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and, Outside Lighting.

No. 38.

The Welsbach Gas Arc for Indoor Lighting.

The cut tells the story—but not all of it. Get one lamp and light it—then the tale's told from beginning to end. For one Welsbach Gas Arc Lamp is a better salesman than 20 pages of advertising.

Here's what it would show if you give it a chance to prove its worth:

1. A mechanical construction and finish that insures the greatest durability.
2. The renewal of mantles and the cleaning of globes without removal of globe.
3. The greatest amount of candle power with least consumption of gas.
4. A by-pass cock so constructed as to permit all or only one mantle burning at a time.
5. A pilot light that consumes but 1 foot of gas in 24 hours. Costs $\frac{1}{10}$ of a cent a day.

Give it a Chance to Tell its Own Story and it Won't Disappoint.

Let us send you one lamp—doesn't cost a fortune—and it will answer every question you put to it; make good on every test given it. You know the only proof of the pudding? What's the use in a fellow telling you it tastes good? Taste it yourself, then you know.

May we Send you ONE Lamp?

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GLOUCESTER, N. J., and CHICAGO, ILL.

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During the Year 1902 has been Awarded Contracts in the Following Places for

Standard Double-Superheater Lowe Water Gas Apparatus.

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Ardmore, Pa.	Hollidaysburg, Pa.	Norwalk, O.
Auburn, N. Y.	Houston, Tex.	Ocean City, N. J.
Belmar, N. J.	Indianapolis, Ind.	Oklahoma City, O. T.
Blue Island, Ills.	Jersey City, N. J.	Oneonta, N. Y.
Boonton, N. J.	Laconia, N. H.	Plainfield, N. J.
Brooklyn, N. Y.	Lakewood, N. J.	Portland, Me.
Carlisle, Pa.	La-Salle-Peru, Ills.	Pottsville, Pa.
Champaign, Ills.	Martinsville, Ind.	Scranton, Pa.
Coney Island, N. Y.	Memphis, Tenn.	South Brooklyn, N. Y.
Dallas, Tex.	Newark, N. J.	Suffern, N. Y.
Danville, Ills.	New Brunswick, N. J.	Swedesboro, N. J.
Des Moines, Ia.	New London, Conn.	Syracuse, N. Y.
Evanston, Ills.	New Orleans, La.	Washington, N. C.
Evansville, Ind.	Norfolk, Va.	Woonsocket, R. I.

TOTAL SETS, 1902, ... 51
TOTAL DAILY CAPACITY, 1902, . . 32,825,000 cubic feet.
TOTAL SETS TO DATE, ... 447
TOTAL DAILY CAPACITY, ... 299,670,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
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Discharging Machinery.

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RETORT WORKS
WORKS, Perth Amboy, N. J.
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Fire Brick, Tiles, Etc.

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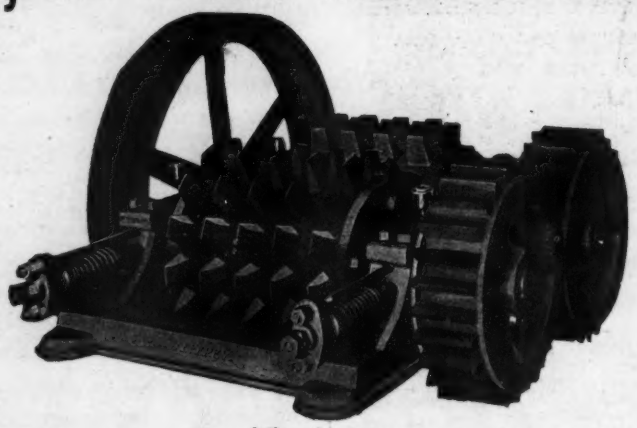

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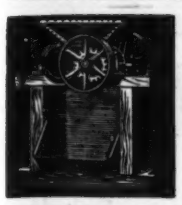

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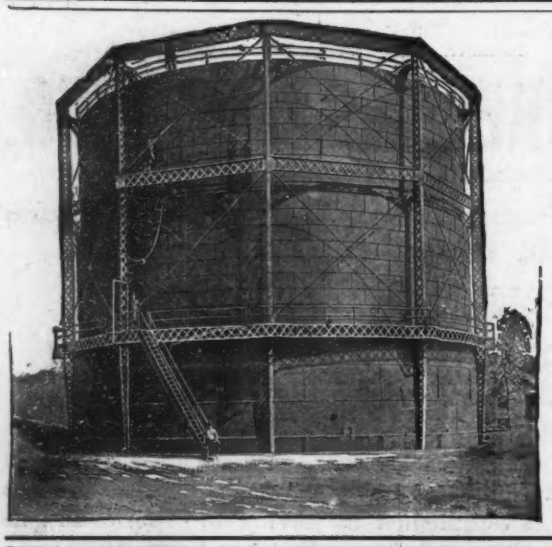

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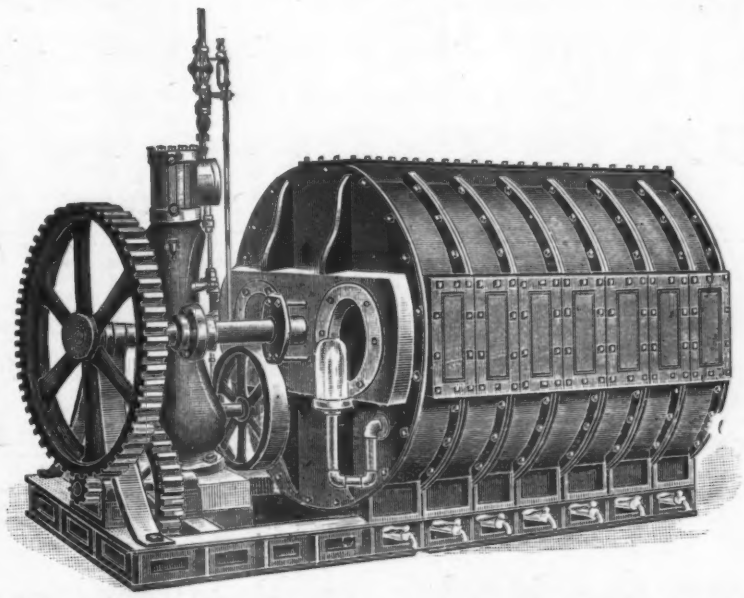

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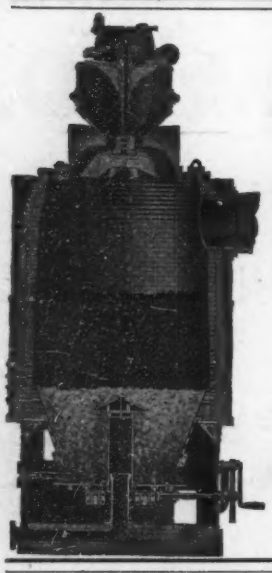

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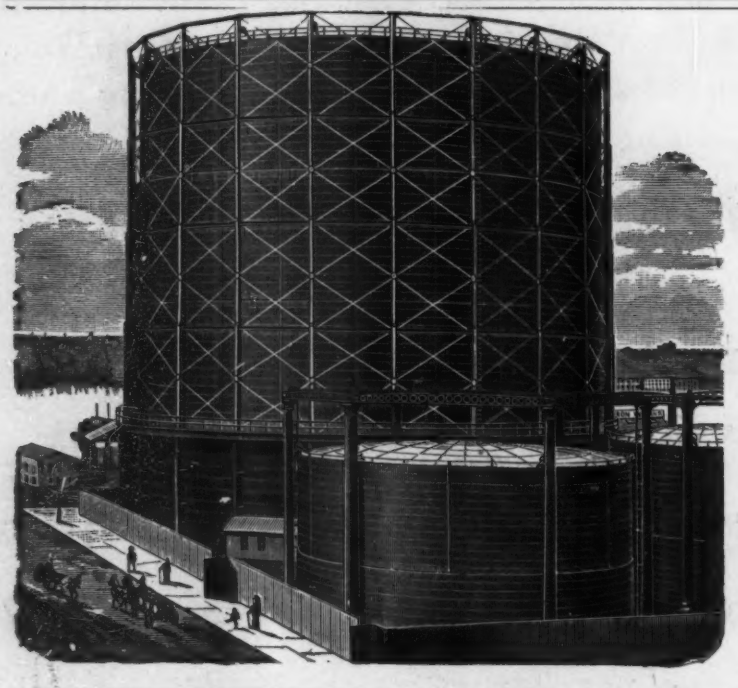

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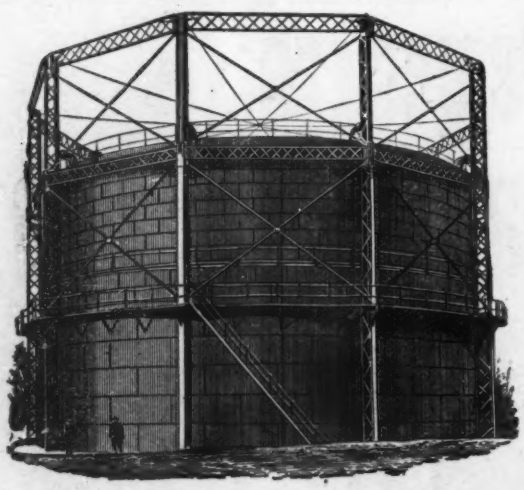

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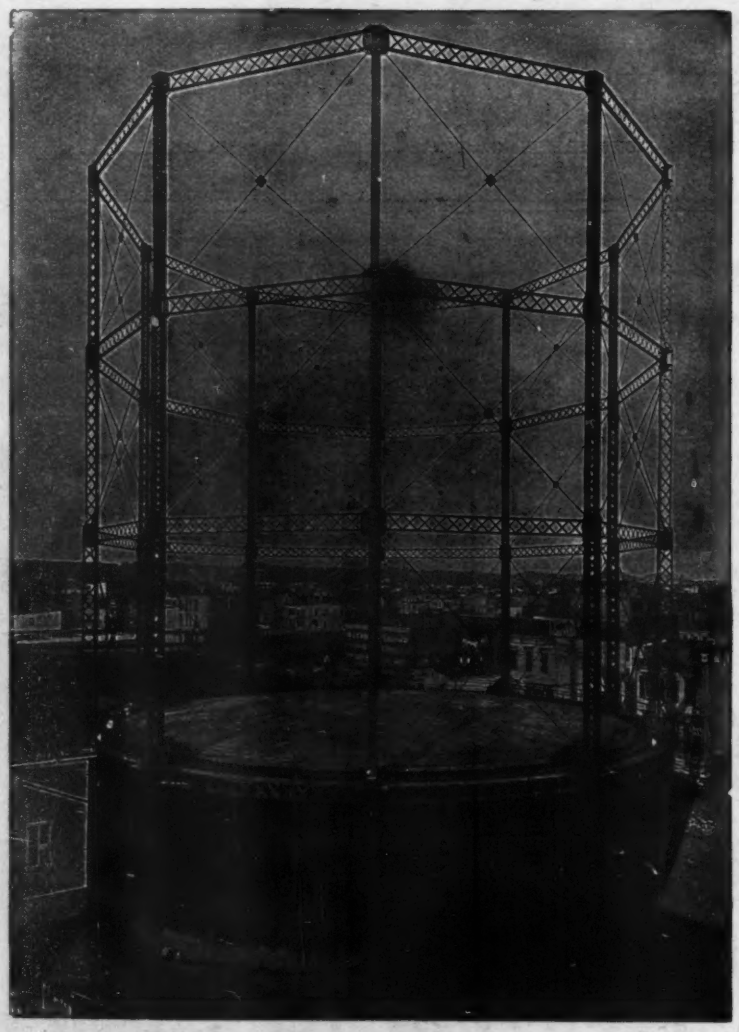

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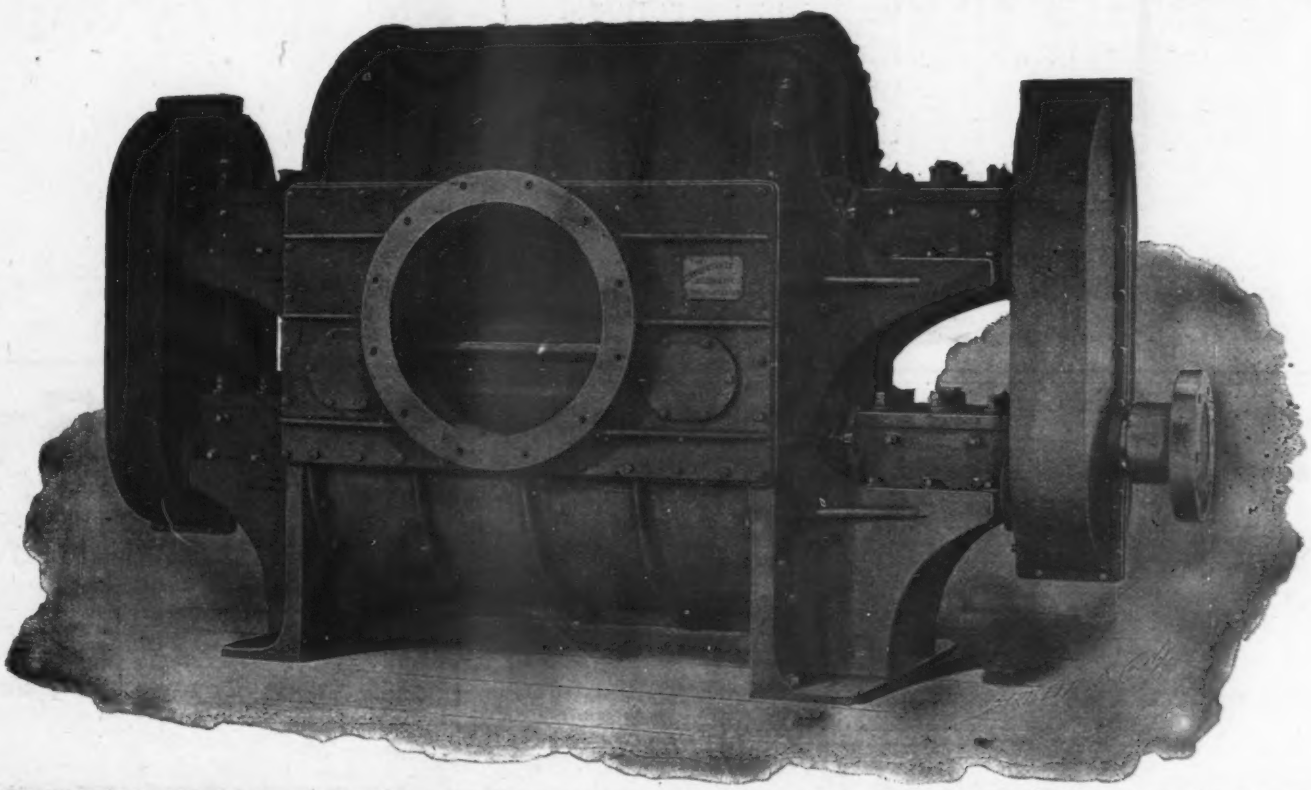

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